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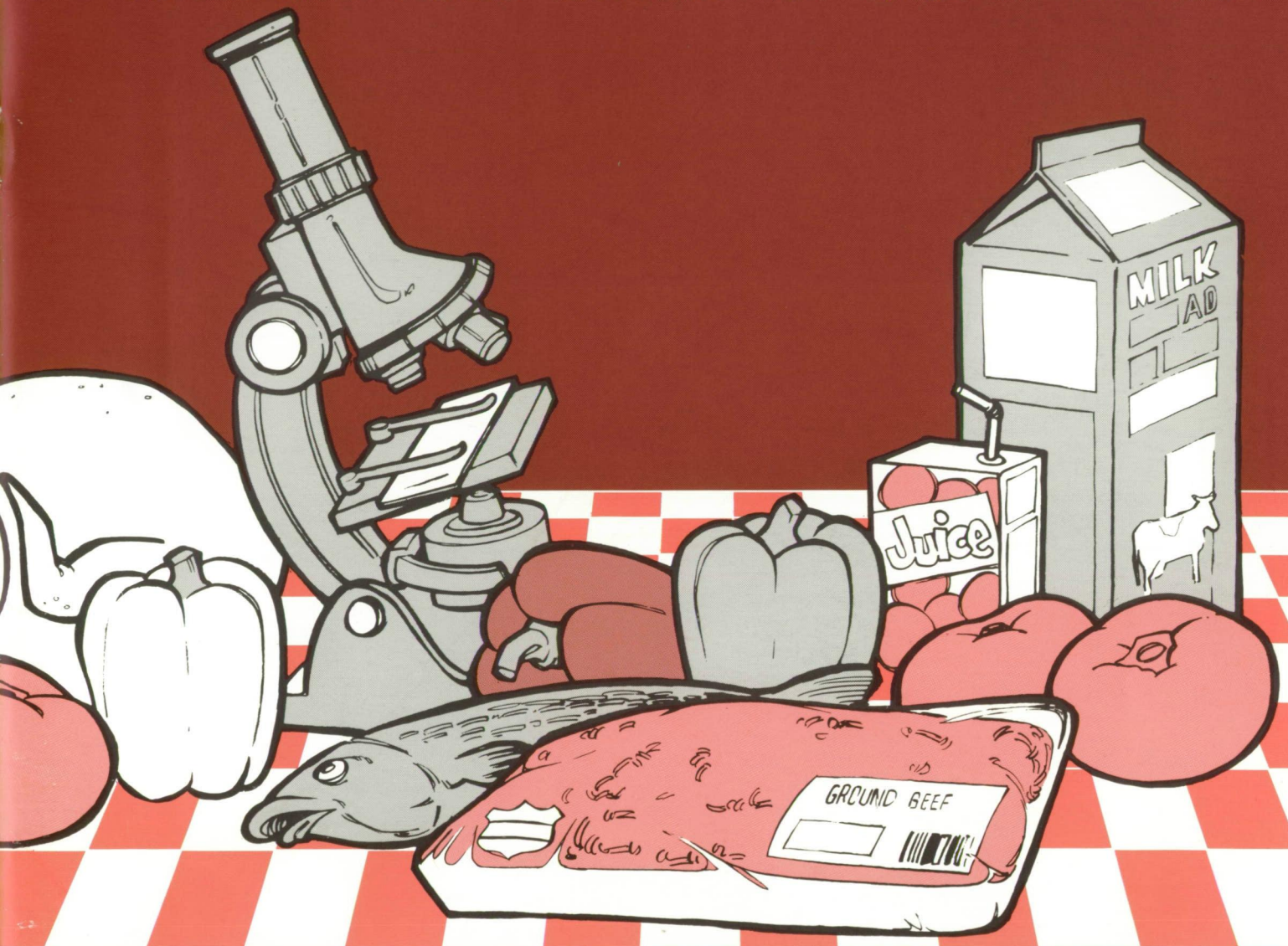

Charting the Costs of Food Safety

...Upfront

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Economic Issues for Food Safety

Food safety is a pressing issue for Government, food manufacturers, retailers, and consumers. Shifts in demographics, changes in eating habits, media coverage of foodborne illness, and advances in science are contributing to the growing demand for increased food safety.

Government regulators and others are responding. For example, USDA's Pathogen Reduction Task Force is coordinating resources to address goals of pathogen detection followed by reduction or elimination and, ultimately, prevention. USDA has hired and trained new inspectors. Newly organized teams conduct unannounced special reviews of meat and poultry plants to make sure food-safety standards are followed. USDA scientists are working with industry to develop rapid tests for identifying and quantifying microbial pathogens as part of USDA's efforts to develop a system for tracing foodborne illnesses back to their source. USDA's food-safety program also involves education for all who handle food, with special efforts targeted at those with the highest risk of foodborne illnesses—the elderly, the chronically ill, and young children.

Food safety is a priority research issue for USDA's Economic Research Service. Economists join with scientists to identify the most serious food-safety problems and the most cost-effective solutions. This issue of *FoodReview* highlights some of this research.

In "New Approaches To Regulating Food Safety," Roberts and Unnevehr point out the need for more accurate assessments of the risks from microbial pathogens and farm chemicals. They also discuss Federal efforts to design regulations that use economic incentives to encourage production of "safer" foods. In "Food-Safety Policy: Balancing Risk and Costs," Aldrich discusses how limited regulatory resources can be pulled away from more serious food-safety risks if consumers' concerns differ from scientists' assessments.

Consumers' concerns can affect their food purchases. In "Food Safety: Meal Planners Express Their Concerns," Lynch and Lin report that a majority of those responding to a USDA study said that food safety was very important. Surveys such as that analyzed by Buzby and Skees in "Consumers Want Reduced Exposure to Pesticides on Food" help determine whether consumers will pay higher prices for safer foods. Yet, consumers are but one factor to consider. Payson, Lin, and Wertz report in "Some Barriers to Organic Produce at the Wholesale Level" that food companies' reluctance to carry organic produce is also a constraint on sales growth.

Economists also analyze the consequences of new food technologies and food-safety regulations. In "Milk and Biotechnology: Maintaining Safe, Adequate Milk Supplies," Blayney examines economic arguments in the hotly contested debate over rbST—a recently approved protein hormone for cows to increase milk production. In "New Inspection Program for the Nation's Seafood," Williams and Zorn estimate health benefits and costs faced by seafood manufacturing plants complying with a proposed seafood-inspection program.

Inside...

Charting the Costs of Food Safety

Also Inside

New Approaches To Regulating Food Safety

Tanya Roberts and Laurian Unnevehr
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The Centers for Disease Control and Prevention (CDC) states that "foodborne disease remains one of the most common and important causes of illness and deaths"—this despite progress in improving the quality of food and food handling in the United States, such as canning, refrigerating, freezing, and pasteurizing foods.

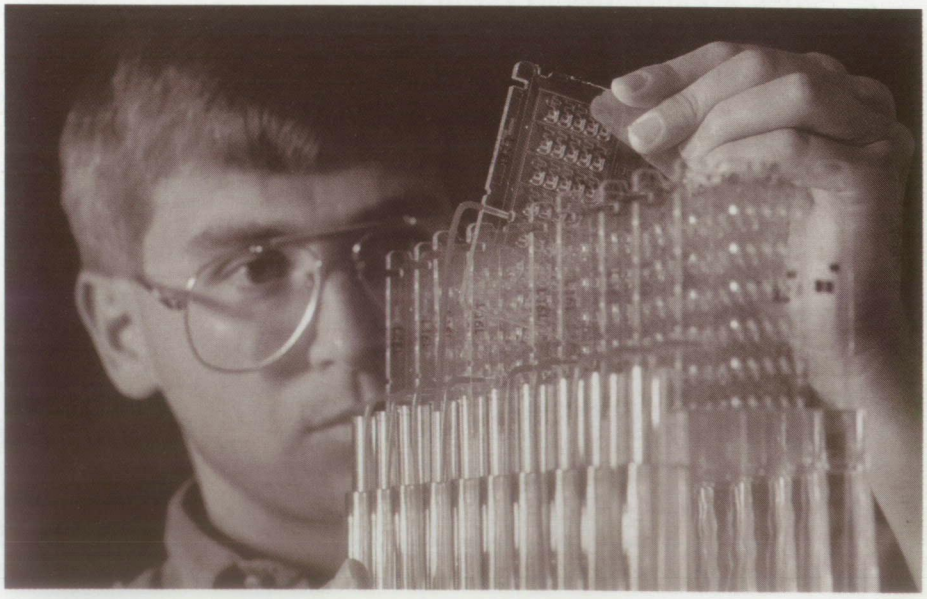
According to researchers at the CDC and the U.S. Food and Drug Administration (FDA), from 6.5 million to 33 million illnesses and up to 9,000 deaths may occur each year from foodborne microbes (namely, bacteria, parasites, viruses, and fungi). For just the few foodborne bacterial and parasitic diseases for which we have made cost estimates, medical charges and lost productivity cost society $5-6 billion annually (see box and table 1).

In contrast to foodborne pathogens—which generally cause illness within hours or months—any toxicological effects from pesticide residues in food, in general, may take decades to manifest their chronic health effects. Such health risks are less easily tied to a particular cause. Most experts agree that pesticide residues in food pose minimal health risks.

Nonetheless, questions continue to be raised about whether such risks are adequately understood and measured. For example, a recent National Academy of Sciences study questioned whether the current assessment of dietary risks from pesticide residues adequately accounts for their effects in children. This uncertainty has contributed to continued consumer concerns about pesticide risks (also see "Food Safety: Meal Planners Express Their Concerns," elsewhere in this issue).

Impetus for Change

Scientific advances are one factor responsible for the increased attention to food-safety regulation. New pathogen tests and improved epidemiological methods link human diseases to their foodborne sources. The *E. coli* O157:H7 outbreak associated with undercooked hamburgers in the West in early



Scientific developments should improve the efficiency of food-safety regulation. The use of risk analysis will improve identification of the causes of foodborne illnesses and deaths, associated foods, control options, and the costs and benefits of these options.

The authors are economists with USDA's Economic Research Service. Roberts is with the Commodity Economics Division and Unnevehr is with the Resources and Technology Division.

1993 is one example. Washington State investigators discovered the outbreak, and epidemiological investigations in California, Nevada, and Idaho uncovered related outbreaks. Since then, several small *E. coli* O157:H7 outbreaks have been detected.

Improved tests for pesticide residues can now detect parts per billion of many chemical compounds, leading to more frequent findings and thereby increasing concern about the existence of pesticide residues in food and water. Even though risks to human health are extremely low at such minute levels, these findings show that consumers are exposed to a number of residues, and the risks from multiple exposures are not well understood or quantified.

The pool of highly susceptible people at risk for microbial foodborne illness is growing, as the population ages, as medical technology keeps ill people alive longer, and as chronic illnesses suppressing people's immune systems (such as AIDS) spread. An aging population also means greater consumer concern about the chronic effects from both microbial and chemical contaminants, which only become apparent with longer life spans. Thus consumers may now place a higher value on reducing risks from microbial pathogens or pesticide exposure than in the past, even though such risks are small (see "Food-Safety Policy: Balancing Risk and Costs," following this article for comparison of foodborne illness with other risks in society).

Setting New Standards

Many different Federal agencies have responsibilities for food safety (fig. 1). For example, FDA has the regulatory responsibility for most foods. The U.S. Department of Agriculture (USDA) inspects meat and poultry. The Environmental Protection Agency (EPA) sets tolerances for pesticide residues in foods. These Federal agencies are trying new approaches to food-safety regulation. Regulations by USDA, FDA, and EPA are under agency, congressional, and Presidential review and debate. Some new initiatives include:

- The Clinton Administration's initiatives to reduce pesticide use/risk and better protect children from residues,
- USDA's Food Safety and Inspection Service's (FSIS) plans to redesign meat and poultry inspection,
- FDA's proposed regulations requiring hazard-control plans for safeguarding seafood, and
- Congressional proposals for a single food-safety agency.

One element of the new food-safety initiatives involves changing the standards for acceptable risks. EPA is responsible for setting pesticide residue tolerances (the maximum level of residue that can legally remain on the food product) for pesticides used on food crops. Presently, under the Delaney Clause of the Federal Food, Drug, and Cosmetic Act (FFDCA), carcinogenic food additives are illegal, without regard to whether the risk is "negligible" and without regard to other characteristics, such as benefits of product use. However, this "zero-tolerance" clause applies only to pesticide residues that are used or that concentrate in processed foods. For fresh foods, small risks are allowed, particularly if there are substantial benefits from product use.

The Administration's legislative proposal calls for a single health-based standard (reasonable certainty of no harm) for risks from pesticide residues in both fresh and processed foods. This is a departure from current policy in two ways. First, concentrations of pesticide residues which pose no more than negligible risks would be allowed in processed foods, in contrast to the current zero-tolerance standard under the Delaney Clause. Second, EPA would no longer consider the benefits from lower production costs in setting tolerances for fresh foods. Changes in existing legislation are required to implement this new standard.

Standards aimed at controlling microbial pathogens are changing for meat and poultry products. FSIS is now rigidly enforcing the zero tolerance for fecal contamination on beef carcasses at the slaughterhouse to reduce the possibility of *E. coli* O157:H7 contamination. Similar changes in poultry slaughterhouse inspections are under consideration to control *Salmonella*. An interagency committee, along with academic and industry members, is investigating setting acceptable levels for other microbial contaminants.

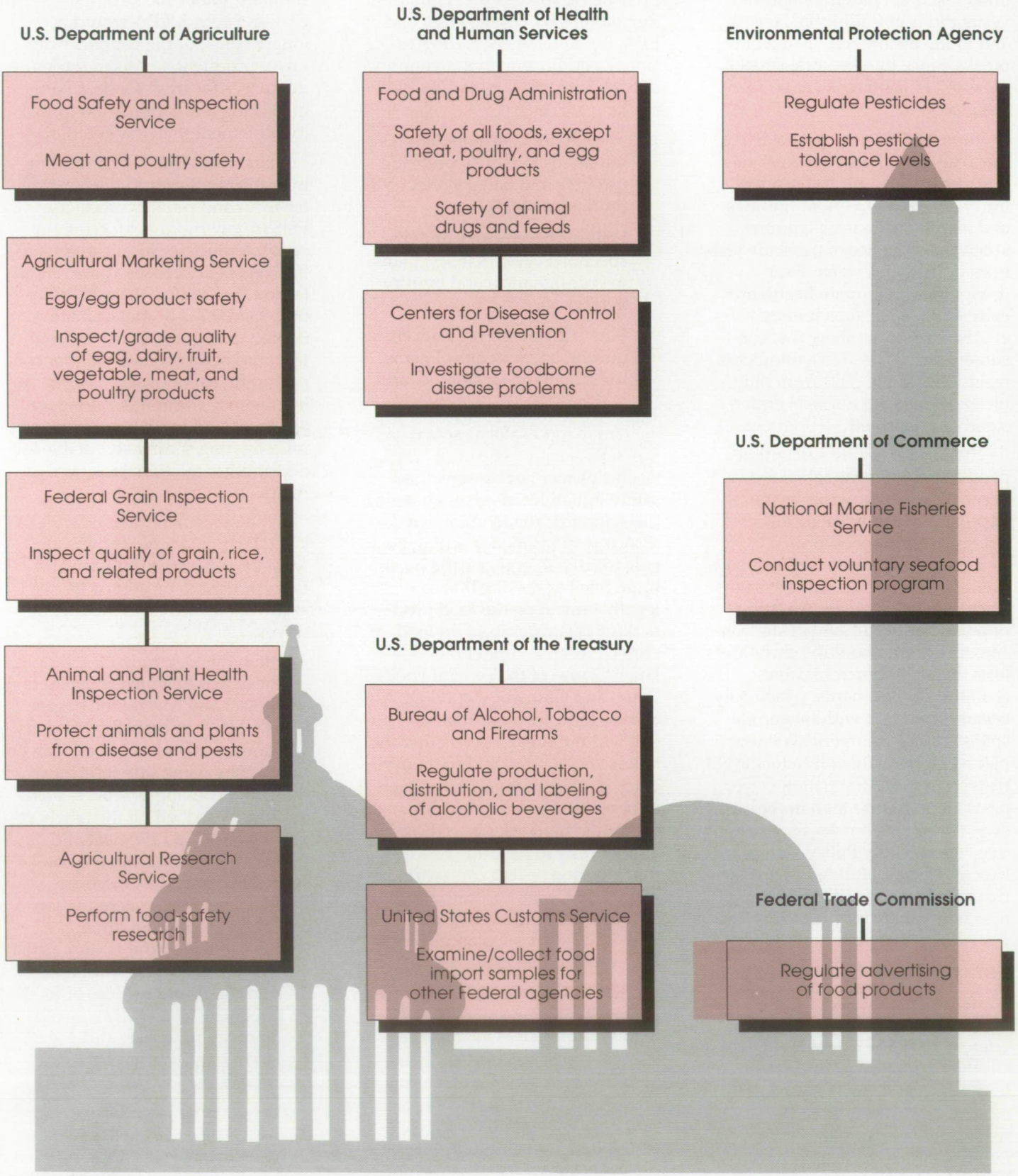
When setting new standards, key questions for consumers are: what do we expect industry and Government to protect us from and what do we expect to do ourselves.

Often this determination hinges on the extent to which consumers can detect and control the degree of risk. Many microbial pathogens, and some pesticide residues, can be reduced by using safe food handling and cooking practices, such as those described on the newly required labels on raw meat and poultry products. From the consumer's perspective, there are tradeoffs between risk reduction and extra preparation time, changes in flavor and texture (such as from cooking meat until it is "well-done"), and the loss of food and fiber (by throwing away old food or trimming fruit and vegetables to reduce external residues and microbes).

Since neither microbes nor residues are visible to the naked eye, the consumer does not know when such precautionary behavior will

Figure 1

Several Federal Agencies Involved in Food Safety and Quality



control potential risks. This lack of control is increasing as consumers purchase more prepared foods and more food away from home. For these reasons, consumers may demand greater Government intervention to reduce hazards in the food supply.

And what of those who are particularly vulnerable to foodborne disease, such as the very young, the very old, and the immunocompromised—including pregnant women? Protecting the most vulnerable, such as children or immunocompromised adults, may result in higher costs for consumers. A similar issue is whether foods could be marketed with different levels of risk to meet individual food preferences. Judgments about acceptable food-safety risks may differ widely among our increasingly diverse population.

Steps To Identify and Control Risks

It is hard to improve food safety when it is unclear to what degree microbial pathogens and chemical residues contribute to human disease. The use of risk analysis will improve identification of the causes of foodborne illnesses and deaths, associated foods, control options, and the costs and benefits of these options.

Some parts of risk analysis may include:

- Identifying foodborne hazards capable of causing human illness.
- Estimating the total number of acute and chronic illnesses associated with each hazard that occurs annually.
- Estimating the number of deaths and illnesses, and the severity of illnesses associated with each hazard (while deaths are the most important measure, the greater number of less severe outcomes, such as illness, could impose greater costs on society).
- Identifying alternative methods of controlling foodborne hazards.
- Estimating the economic costs and benefits of the proposed control technology and the distribution of such costs and benefits.

The Administration's pesticide legislative proposal responds to the 1993 National Academy of Sciences (NAS) recommendations by requiring specific findings regarding the safety of infants and children in setting pesticide tolerances. Such findings must account for differences between adults and children in terms of body weight, dietary patterns, and vulnerability to developmental toxicity. Children consume more food per unit of body weight than do adults and consume a limited diet. Therefore, their relative exposure to particular residues can be higher than that of adults, with potentially higher risks.

NAS also recommended reducing the acceptable intake limits for pesticide residues when data on developmental toxicity are questionable or inadequate, accounting for nonfood sources of residue intake, and accounting for the combined effect of intake of multiple pesticides with similar toxic effects.

These recommendations, taken together with the application of a negligible risk standard, could result in revocation of some existing pesticide tolerances.

In contrast to pesticides, little formal risk analysis has been carried out for microbial pathogens in the past. While the U.S. Department of Health and Human Services, in its publication *Healthy People 2000*, did set targets for reduction of four bacterial pathogens (50 percent for *Campylobacter jejuni* and *E. coli* O157:H7, 29 percent for *Listeria monocytogenes*, and 11 percent for *Salmonella*), there are no definitive or commonly accepted estimates of human disease and deaths caused by most bacterial, viral, parasitic, and fungal foodborne pathogens.

Improving data collection for microbial pathogens will result in more accurate risk analysis. For example, much can be accomplished by better integrating existing databases on human hospitalizations and deaths caused by specific pathogens with new FSIS data, such as their baseline studies for pathogen counts on beef, chicken, and pork. Random samples of condemned animals can be analyzed to discover the causative pathogens. More CDC studies could be funded to identify the foods associated with specific pathogens, identify high-risk population groups, standardize estimates of cases/deaths across pathogens, and investigate the chronic diseases that may have foodborne origins. Such analysis is expensive. Yet given the $5-6 billion in medical costs and productivity losses each year for a few microbial pathogens, even modest reductions in foodborne diseases would justify improved data collection for microbial pathogens.

Imposing New Types of Regulation

In addition to strengthening existing regulation and risk analysis, the Administration is trying new methods of regulation. These would put in place a process that reduces risk by prevention throughout the food production process, instead of primarily inspecting or testing finished products. A systems approach, such as Hazard Analysis Critical Control Points (HACCP), may reduce contaminants most effectively by identifying potential points at multiple stages of the production and marketing chain where interventions can prevent or reduce foodborne contamination.

Cost of Illness Estimates and Methodology

The annual cost of U.S. foodborne disease associated with selected bacterial and parasitic pathogens is estimated using the traditional cost-of-illness method. This analysis includes only medical costs, productivity losses, and special education/residential care because of some chronic conditions. The basis of the disease estimates is "best estimates" of the actual number of foodborne disease cases each year and is not limited to the much smaller number of outbreaks reported to the Centers for Disease Control and Prevention (CDC).

The present value of lifetime medical costs for those becoming ill in 1992 is estimated using nationwide databases, such as the published Medicare reimbursement rates and per capita expenditures on physicians' services from the Health Care Financing Administration, the National Center for Health Statistics' National Hospital Discharge Survey, the American Hospital Association's Hospital Statistics, or Blue Cross/Blue Shield charges. The average cost to community hospitals per patient is used to compute hospitalization costs.

Productivity losses because workers were ill and missed work are approximated by the Average Weekly Earnings for nonsupervisory production workers in private nonagricultural jobs, published by the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor, plus estimated fringe benefits. For those ill in subsequent years, a present value of the reduced stream of earnings is calculated. For those who die, Landefeld and Seskin's human capital/willingness-to-pay method is used. It combines elements of both methods to generate the present value of expected lifetime after-tax income and housekeeping services at a 3-percent real rate of return, adjusted for an annual 1-percent increase in labor productivity and a risk-aversion premium that increases the estimates by 60 percent.

These cost estimates are based on the annual incidence of disease, rather than on the prevalence, because the goal is to develop public-health cost estimates to compare to the costs of various prevention programs. Incidence estimates are the annual increase in cases and associated disease costs. Intervention today which prevents future cases will eliminate all the economic costs of prevented cases—this is the economic benefit of disease prevention.

For more detail on how the estimates are calculated, see "*E. coli* O157:H7 Ranks as the Fourth Most Costly Foodborne Disease" by Suzanne Marks and Tanya Roberts in *FoodReview*, Vol. 16, No. 3 (Sept-Dec 1993), pp. 51-59.

FDA recently proposed regulations for a HACCP system to increase seafood safety (see "New Inspection Program for the Nation's Seafood," elsewhere in this issue). FSIS is considering similar action for meat and poultry plants. This type of system can be applied to interventions anywhere in food production. Early intervention points can prevent contaminants from entering the food production/distribution system, while later interventions can eliminate certain kinds of contaminants.

- For example, three farm practices have been effective in dramatically reducing *Trichinella spiralis* in U.S. hogs: keeping rodents out of hog production houses, quickly taking dead hogs out of pens, and cooking all hog feed containing meat scraps or other animal byproducts.
- An example of intervention close to the consumer is the label on raw beef instructing preparers to refrigerate raw and cooked food, to wash hands, to avoid cross-contamination by washing cutting boards and knives after use, and to cook meat until it is well-done.

A similar focus on production process rather than endpoint outcomes is found in the Administration's reduced use/risk initiative for pesticides. In the past, environmental and health risks from pesticides have been addressed by banning products. This results in the loss of pest-control alternatives. Instead, reducing the use of pesticides can prevent significant environmental and health risks while also retaining flexibility in pest control. Promoting the judicious use of chemicals within a total system of integrated pest management will be the approach to reducing use.

Use of a process standard rather than product sampling and testing could also be applied to imported foods. Certifying that production processes in an exporting country meet U.S. standards could be a

Table 1
Estimated Medical Costs and Productivity Losses for Selected Foodborne Pathogens, 1992

Foodborne pathogen	Estimated annual foodborne— Cases	Deaths	Estimated total costs
	Number	*Number*	*Million dollars*
Bacteria:			
Salmonella	1,920,000	960-1,920	1,188-1,588
Campylobacter jejuni or *coli*	2,100,000	120-360	907-1,016
Escherichia coli O157:H7	7,668-20,448	146-389	216-580
Listeria monocytogenes	1,526-1,581*	378-433	209-233
Parasites:			
Toxoplasma gondii	2,090	42	2,628**
Trichinella spiralis	131	0	0.8
Taenia saginata	894	0	0.2
Taenia solium	210	0	0.1***
Total			5,149-6,046

Note: The analysis assumes that 100 percent of human illnesses are foodborne for *Campylobacter, Escherichia coli, Trichinella,* and the *Taenias* and that 96 percent of *Salmonella* cases, 85 percent of *Listeria* cases, and 50 percent of *Toxoplasma* cases are foodborne.
*These case estimates may be high. **Productivity losses are high for survivors who develop mental retardation or blindness as a result of toxoplasmosis. These costs exclude toxoplasmic encephalitis infections in 2,250-10,200 AIDS patients annually, which are a significant cause of premature death (50 percent of cases may also have a foodborne origin). ***Estimates do not include costs for cystericercosis, which may have an indirect foodborne transmission. Sources: M. Weiss, T. Roberts, and H. Linstrom, "Food Safety Issues: Modernizing Meat Inspection," *Agricultural Outlook*, USDA, ERS, June 1993, pp. 32-36; Centers for Disease Control and Prevention and W.K. Viscusi, "The Value of Risks to Life and Health," *Journal of Economic Literature*, Vol. 31, No. 4, 1993, pp. 1,912-1,946; and S. Marks and T. Roberts, "*E. coli* 0157:H7 Ranks as the Fourth Most Costly Foodborne Disease," *FoodReview*, Vol. 16, Issue 3, USDA, ERS, Sept.-Dec. 1993, pp. 51-59.

more efficient way of ensuring the safety of the rapidly growing U.S. food imports than would be testing each product at the border. FDA is employing this concept for some imported produce, for example. New Zealand is ensuring for some of its exported produce that pesticide use follows U.S. registered pesticide uses and, therefore, the produce should meet U.S. pesticide residue limits.

Using Economic Incentives

Vice President Gore's *Report of the National Performance Review* proposed ways to make the Federal Government more efficient and more responsive. Among other things, the report advocates using incentives to reward firms with strong safety records and enforcement to punish firms with poor performance.

Economic incentives are a very efficient mechanism for sending signals to the market and encouraging production of products with desirable characteristics, such as safety. In the short run, firms can increase testing for contaminants and buy from suppliers whose quality-control procedures demonstrate compliance with requisite standards. In the long run, research on new production practices is encouraged as is research to develop new, safer products.

Existing food-safety regulations were designed to provide safe food for the average consumer. The safety standards set in the Federal Meat Inspection Act and Poultry Products Inspection Act have become, in effect, a floor and a ceiling for the degree of safety that meat and poultry products are expected to attain. Similarly, pesticide tolerances set under the FFDCA are uniform for each crop/chemical combination; that is, there are no differences in tolerances for children's foods.

Doctors, however, are warning some individuals at increased risk for microbial foodborne disease, such as pregnant women and AIDS patients, not to consume certain

fresh seafood, meat, or dairy products and instead substitute medical, canned, and well-cooked foods. It may make sense to offer these high-risk individuals more choices for the fresh products as well. Irradiated chicken is a start and is being sold in a few markets. But, there may be other methods of reducing pathogen levels on fresh meat, poultry, seafood, and dairy products. Regulators could stipulate what product-safety targets must be met for such products, let approved products carry a special label, and thereby give industry an incentive to discover innovative methods to reduce pathogen levels.

U.S. dairy producers have already discovered that market incentives can be positive as well as negative. Prices received by farmers for their milk are partially tied to somatic cell, standard plate, and preliminary incubation counts for bacteria. Low test results are indicators of both longer product shelf-life and reduced levels of bacteria, some of which may cause human illness.

Dutch producers have proposed obtaining premium prices for pork produced under hygienic codes to reduce foodborne pathogens. These codes are currently being tested in actual production situations and are expected to be implemented in 1995. "Safer" products need a grade, symbol, or label on products for the final consumer, who will choose whether to alter purchasing patterns based on food-safety considerations (also see "Consumers Want Reduced Exposure to Pesticides on Food," elsewhere in this issue).

Another way to provide incentives is to encourage the development of safer products. EPA has moved to provide incentives for development of reduced-risk pesticides and biological alternatives through streamlining the registration process and removing unnecessary data requirements for biologicals. The Administration's pesticide legislative proposal would provide further incentives for development of reduced-risk alternatives, by giving them priority in the registration review and allowing temporary and conditional registrations prior to completion of all required tests.

Continued Challenges in the Next Decade

Scientific developments should improve the efficiency of food-safety regulation. Epidemiology is improving our ability to identify acute and chronic human illnesses caused by foodborne pathogens. We will have better estimates of the medical and economic burdens associated with specific pathogens and chemicals. Continued development of inexpensive, rapid tests will allow detection of contaminants in foods and permit statistically based testing. Economic incentives for improving food safety will be better understood and utilized in designing regulations.

Demand for food-safety regulation may grow due to changes in food demand and demographics. An older and more affluent population may be more willing to pay for health attributes of food. The growing popularity of convenience foods further reduces consumers' control over food preparation and may alter the nature of foodborne illness risks. A growing population of high-risk consumers means that for a given number of pathogens in food, more people are likely to get sick. Whether these changes will result in a market response from industry or greater demand for regulation remains to be seen.

All these forces will challenge regulators to develop food-safety strategies that are scientifically and economically sound.

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Food-Safety Policy: Balancing Risk and Costs

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The United States is often said to have the safest food supply in the world, yet some consumers and policymakers counter that it is still not safe enough. The U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services are continually examining ways to reduce the risk of foodborne illnesses.

But regulatory actions come at a cost to the Government, industry, and consumers. These costs can in turn raise prices for consumers. On the other hand, greater safety may not cost significantly more if it can be achieved through stricter control of existing practices.

With budgets stretching ever tighter, tradeoffs are involved. Those concerned with food safety are asking: How much risk does each individual actually face from foodborne illnesses? And, how much should society pay to reduce that risk?

Although it is difficult to determine the total amount spent on food safety by the Federal Government, local and State authorities, the food processing and distributing industry, and consumers, the total is high.

Many Federal agencies are involved in ensuring the safety of the U.S. food supply. Expenditures on food safety by FDA alone totaled $206.3 million in fiscal 1992, up from $93.8 million in fiscal 1980. USDA's Food Safety and Inspection Service (FSIS) spent about $473.5 million in fiscal 1992, down from $530.7 million in fiscal 1980. Furthermore, Government expenditures are a small part of the total, because most of the cost of regulation is paid by private parties—processors, retailers, and food-service operators—complying with health regulations.

Foodborne Illnesses Vary in Frequency and Severity

Since a risk-free existence is not possible, society must decide how much it is willing to spend on public safety and where these dollars

The cost of additional Government regulation to reduce foodborne disease will be shared by all consumers. Because foodborne illnesses vary in frequency and severity, the costs for each alternative need to be carefully identified and compared with the reduction in risks.

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will have the greatest impact. The likelihood and severity of the risk, as well as its distribution in the population, are all factors to consider.

The probability of a person becoming infected at some time with either *Salmonella* or *Campylobacter*—two of the most common foodborne bacteria—is estimated at 1 in 65 people per year.

At the lower end of the probability scale, the risk of death from *E. coli* 0157:H7 (the bacterium responsible for deaths from fast food in Washington State in January 1993) is between 1 in 700,000 and 1 in 1,700,000 people per year. The range is large because many cases may not be identified or reported to health authorities.

The consequences of foodborne illnesses can range from a bout of mild diarrhea to an extensive hospital stay or even death. *Salmonella* and *Campylobacter* each cause about 2 million cases annually, but salmonellosis is more likely to be fatal. The risk of dying is estimated to be 5 to 8 times higher for salmonellosis than for campylobacteriosis. That is, about 1 in 1,000 to 1 in 2,000 cases of salmonellosis results in death, compared with 1 out of 21,000 to 4 out of 21,000 cases of campylobacteriosis.

The consequences depend on the virulence of the microorganism, how much of the microorganism the person consumed, and whether the person's immune system can fight against the microorganism. Certain segments of our society—infants and children, the elderly, and immunosuppressed individuals—are at higher risk.

Benefits, While Large, Are Difficult To Pinpoint

There are two approaches to estimating the benefits of reducing foodborne illness—benefits that can be compared to costs in allocating budget dollars to food safety.

The first method is to consider the benefits as costs avoided—lost wages and medical costs. This is a very conservative approach. It does not take into account the value people place on being well and on avoiding premature death. Considering only the cost of medical care and lost wages implies that longer life and health are valued only because they contribute to earnings and avoid doctor bills. Clearly, longer life and better health are ends in themselves. USDA generally has used the medi-

Table 1
Alternative Valuations of Reducing Deaths From Foodborne Illnesses

			Two approaches to measuring benefits		
			Medical costs and lost wages[1]		Implied value of avoiding deaths[2]
Foodborne pathogens	Estimated cases	Estimated deaths	Medical costs for all cases and lost wages for survivors	Lost wages due to deaths	(deaths only)
	Number	*Number*	*Million dollars*		*Million dollars*
Bacteria:					
Salmonella	1,920,000	960-1,920	839-889	349-699	3,840-13,440
Campylobacter jejuni or *coli*	2,100,000	120-360	863-885	44-131	480-2,520
Escherichia coli O157:H7	7,668-20,448	146-389	34-91[3]	182-489[3]	584-2,723
Listeria monocytogenes	1,526-1,581	378-433	106	103-127	1,513-3,034
Parasites:					
Toxoplasma gondii	2,090	42	2,610	18	167-293
Trichinella spiralis	131	0	.8	NA	NA
Taenia saginata	894	0	.2	NA	NA
Taenia solium	210	0	.1	NA	NA
Total			4,453-4,582	696-1,464	6,584-22,010

Notes: 1992 cost data. Excludes toxoplasmic encephalitis infections in 2,250 to 10,200 AIDS patients, 50 percent of which may have a foodborne origin. Costs exclude cystericercosis, which may have indirect foodborne transmission. NA = Not applicable. Sources: This table further divides the data presented in "New Approaches To Regulating Food Safety" by Tanya Roberts and Laurian Unnevehr, elsewhere in this issue. For further details, see also: [1]M. Weiss, T. Roberts, and H. Linstrom, "Food Safety Issues: Modernizing Meat Inspection," *Agricultural Outlook*, USDA, ERS, June 1993, pp. 32-36; [2]Centers for Disease Control and Prevention and W.K. Viscusi, "The Value of Risks to Life and Health," *Journal of Economic Literature*, Vol. 31, No. 4, 1993, pp. 1,912-1,946; and [3]S. Marks and T. Roberts, "*E. coli* 0157:H7 Ranks as the Fourth Most Costly Foodborne Disease," *FoodReview*, Vol. 16, Issue 3, USDA, ERS, Sept.-Dec. 1993, pp. 51-59.

cal costs and lost wages approach in order to avoid overstatement.

Another way to measure benefits is to find records of how much people have paid to avoid death and disease. Consumers, often without realizing it, place such a value on life and health when they pay more for safer products or earn higher wages by taking jobs that incur risks. Economists have calculated this "implied value" of saving a life through these choices at $4 million to $7 million. This approach yields higher benefits from reducing foodborne diseases than does the approach based on medical costs and lost wages. FDA and some other Federal agencies have used the implied value approach for analyses of proposed rules. (Economists have not been able to reach consensus estimates for reductions in nonfatal illnesses and disabilities because of the wide range of severity.)

Theses two methods yield different levels of benefits to society. While eliminating *Salmonella* would generate $1.2 billion to $1.6 billion in avoiding medical costs and lost wages (from about 1,920,000 illnesses and 960-1,920 deaths), eliminating only the deaths would be valued at $3.8 billion to $13.4 billion by the implied value approach. While the total costs saved (by eliminating eight microorganisms for which USDA has made estimates) is $5.1 billion to $6.0 billion annually by the medical costs and lost wages approach (see table 1), the value of the lives saved alone would be $6.6 billion to $22.0 billion each year under the implied value approach.

Foodborne Illness One of a Number of Threats

Consumers continually face a number of risks that can lead to premature death, of which foodborne illness is but one (table 2). The risk of death from foodborne illness is 1 in 29,000—a greater probability than dying in a fire, but less of a risk than having a fatal motor vehicle accident.

The risks reported below reflect the risks of fatal incidents after the intervention of health and safety systems and regulations. For example, public-safety systems and regulations—such as mandatory sprinkler systems in hotels and other building codes or the use of fire-resistant material for infant sleepwear—as well as private safety measures, such as installing a smoke detector, have reduced the annual risk of death in fires to 1 in 50,000.

Similarly, food-safety practices or regulations, such as meat and poultry inspection and adequate cooking of foods, are responsible for lowering the risk of fatal encounters with foodborne pathogens.

Table 2
Annual Fatality Risk From Selected Events

Source of risk	Risk of fatality
	Probability in population
Cigarette smoking (per smoker)	1/150
Cancer	1/300
Motor vehicle accident	1/5,000
Work accident (per worker)	1/10,000
Home accident	1/11,000
Foodborne illness (all food)	1/29,000
Poisoning	1/37,000
Fire	1/50,000

Sources: W.K. Viscusi, "The Value of Risks to Life and Health," *Journal of Economic Literature*, Vol. 31, No. 4, 1993, pp. 1,912-46. J.V. Bennett and others, "Infectious and Parasitic Diseases," *Closing the Gap: The Burden of Unnecessary Illness*, NY: Oxford University Press, 1987. USDA's Economic Research Service.

Consumers Confused About Risks

Contracting a foodborne disease is one of a number of risks that society faces everyday (see box), but certainly not the greatest hazard. Research by social scientists indicates that sometimes the general public underestimates relatively high probabilities of risk (such as dying in a automobile accident) and overestimates low probabilities of risk (such as dying in a fire). Possibly this is because familiarity (such as with automobiles) creates a sense of the "safe and ordinary," while the uncommon (such as the risk of contracting a relatively rare foodborne disease) can become distorted due to publicity.

The possibility that risks could be systematically misunderstood has several implications for food-safety regulators. For example, consumers may underestimate the relatively high probability of a generally nonfatal illness (such as sal-

monellosis), thereby handling food improperly or failing to encourage elected officials to support Government safety efforts in these areas. Consumers may overestimate the low probability of other health risks (such as botulism or trichinosis) and demand more regulations than the risk warrants to guard against these hazards, which may be more serious but less likely to occur than others. Such misperceptions about food-safety risks pull limited resources away from other more serious food-safety risks.

Information Is the Key

If consumers had complete information about the characteristics of a product—including the risks associated with consuming it—producers would need to reduce the risks to acceptable levels or risk losing sales. (Of course, consumers' "acceptable" levels may still be quite risky.) However, consumers rarely have complete information, especially about food products. For example, consumers do not know the safety procedures used by meat and poultry processors, so they cannot choose meat and poultry products on this basis.

Even when consumers' information about the production of a product is incomplete, regulation may not be necessary. Reportage, consumer experience, warranties, and legal proceedings sometimes have the effect of remedying consumers' information gaps. But these mechanisms rarely apply to foodborne illnesses, because it is often difficult to connect an illness with the source of a raw product, even if the actual cooked or processed food which caused the illness is identified. For example, beef from several slaughterhouses may be combined into a shipment of hamburger delivered to a fast-food chain, making it difficult to determine where the problem originated.

Also, the illness often occurs in a different time and place from the consumption of the product. Symptoms may arise after several hours or days, during which time various other foods may have been consumed. A large proportion of foodborne illnesses are not reported to public health officials or food retailers. These problems remove the market discipline experienced by producers of more easily identified and traced products.

In some segments of meat and poultry markets, brand names and producers' regard for reputation do offer consumers partial protection from illnesses caused by pathogens in the products. To protect the value of reputation, many producers make extensive efforts to avoid the possibility of contamination that could produce an outbreak of disease.

Education for food workers and consumers (particularly high-risk individuals) about safe food preparation is one approach to curtailing foodborne illnesses.

How Much and What Kind of Regulation?

Because many of the traditional mechanisms to deter unsafe products—such as consumer experience with the product, warranties, legal liability—are not easily applied to food products, there remains a need for education and Government regulation.

But how much regulation? Possibly more, or different, regulations than currently exist, given apparent public concern with food safety (see "Food Safety: Meal Planners Express Their Concerns," elsewhere in this issue).

Alternative policies include more specific regulations, such as requiring carcasses to be sprayed with pathogen-reducing substances in slaughterhouses. FDA has proposed a new program for seafood safety, which focuses on regulating the producer's safety control process in addition to detecting contaminants (for more details, see also "New Inspection Program for the Nation's Seafood" in this issue). USDA is considering similar action for meat and poultry plants.

Education for food workers and consumers about safe food preparation is another approach to curtailing foodborne illnesses. FDA has recently issued the *1993 Food Code*, which provides Federal recommendations on proper food-safety procedures by retail establishment employees.

The costs, public and private, for each alternative need to be carefully identified and compared with the reduction in risks. Different policies, or combinations, will be

appropriate in different circumstances.

Educational programs, for example, may be a good approach for particularly high-risk individuals, such as infants, the elderly, and the immunocompromised. The high-risk population, or their caretakers, may be able to take precautions, which could be unnecessarily costly if imposed on the whole population. Alternatively, food products that have been produced under stricter standards could be certified for these groups.

Other approaches are also possible (see "New Approaches To Regulating Food Safety," elsewhere in this issue). None will come without costs, which will be shared by all consumers—through either purchase costs or taxes. The challenge is to use the expenditures wisely.

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Food Safety: Meal Planners Express Their Concerns

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Participants in a recent national survey expressed a general lack of confidence that the existing regulatory system protects them from risks of unsafe food. Most of those surveyed thought using antibiotics or hormones in livestock, or pesticides on crops—even at approved levels—was not safe. Echoing this perception was a large group that did not believe pesticide risks were well understood or that pesticides should be used in food production.

Such concerns over food safety were broad-based. Of the five foods and practices considered unsafe by at least three-fifths of respondents, two were related to the threat of microbial pathogens (in very rare beef and raw shellfish), one to new technologies (irradiation), one to preservatives (nitrite), and one to pesticide residues on food.

Some respondents could not judge whether certain food production practices (such as the use of nitrite, irradiation, and hormones) and imports were safe, and may have lacked the necessary information to decide.

A variety of factors may have worked in concert to raise society's concerns over food safety in the last decade: extensive media attention given to food-safety problems; greater awareness of the relationship between agricultural production techniques, food quality, and human and environmental safety; and a growing general awareness of the relationship between diet and health.

These factors, among others, have contributed to the deterioration of consumer confidence in the regulatory system's ability to protect them from harm. Part of this reflects the public's growing skepticism regarding the Government's ability to regulate risks and its abil-

Forty-two percent of those responding to the survey said that they have become more concerned about food safety. They expressed concern over a broad spectrum of issues surrounding foods and food production and processing practices.

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ity to regulate the food industry. Compounding the uncertainty may be a lack of scientific consensus regarding the magnitudes of health risks posed by pesticide residues and microbial pathogens in food and in the environment.

The Diet and Health Knowledge Survey

To understand such concerns, USDA's Agricultural Research Service (ARS) asked some questions regarding food-safety issues in the Diet and Health Knowledge Survey (DHKS)—a major nationally representative survey on meal planners' attitudes and perceptions of the relationship between diet, nutrition, and health.

This article reports on information gathered in the 1990 survey (data from the 1991 survey were not available when this article was written). The survey questioned the main meal planners and/or preparers, about 80 percent of whom were women, in roughly 1,900 households. Thus, the findings reported in this article may not represent all consumers in the Nation.

Food-Safety Concerns on the Rise

Many of those responding to the survey said that they were more concerned in 1990 than in 1989 about food safety: 42 percent indicated that their concern about food safety was "higher now than a year ago." Over half (55 percent) felt no different, and only 2 percent were less concerned.

Bacteria and parasites in foods were cited by nearly half the respondents as the most important of four food-safety concerns listed (table 1). Almost a quarter were most concerned about pesticide residues on fruit and vegetables. Smaller groups identified drug residues in animal products and food additives as their most important food-safety concern.

Table 1
Respondents' Most Important Food-Safety Concerns

Issue	Food-safety issues concerning respondents
	Percent
Bacteria and parasites in food	49
Pesticide residues on fruit and vegetables	23
Drug residues in animal products	12
Food additives	3
Not concerned about any of the above	8
Don't know or no response	5

Concern Over a Wide Array of Issues

A broad spectrum of food-safety issues concerned respondents (fig. 1). Survey participants were asked to judge the safety of a list of foods and food production and processing practices. They were offered the choice of responding "safe" or "not safe" to the questions posed.

Foods

The majority of respondents were not aware of a major health hazard: raw eggs. Eggs contaminated with *Salmonella enteritidis* have been associated with increasing cases of foodborne illness. While pasteurized eggs used in some commercially prepared foods are free from the microbial pathogen, raw eggs sold in retail markets may be contaminated. Homemade foods containing raw eggs can pose a health threat. However, over half the survey respondents thought foods made at home containing raw eggs were safe, while 40 percent judged them unsafe.

Respondents seemed to be better informed about risks from seafood (fish and shellfish). The greatest number of seafood-associated illnesses stem from raw mollusks (oysters, clams, and mussels) harvested from waters contaminated with raw or poorly treated human sewage. Lack of adequate cooking allows viruses or bacteria (normally killed by heat) to be ingested. Sixty-five percent of respondents considered raw shellfish unsafe.

A large majority of respondents (80 percent) felt that eating cooked fish was safe, while 16 percent thought that it was not safe. According to the Centers for Disease Control and Prevention (CDC), people face a smaller risk of foodborne illness from eating cooked fish (finfish and crustacean shellfish such as shrimp) than from eating cooked chicken or raw molluscan shellfish, if the same quantity of each is eaten (the CDC document refers to "fish" and "chicken;" we assume most fish and chicken are cooked prior to eating).

Respondents also were aware of the risk from eating raw and undercooked beef. Seventy-one percent said that very rare beef was not safe. Raw and undercooked beef may contain excessive amounts of parasites and microbial pathogens, which exist naturally in the animal's environment. Microbial pathogens may be introduced dur-

ing animal-raising, slaughtering, processing, handling, and final preparation. Food-safety experts recommend that consumers cook meat thoroughly and avoid the consumption of raw and undercooked meat, particularly ground meat, in order to avoid foodborne illness.

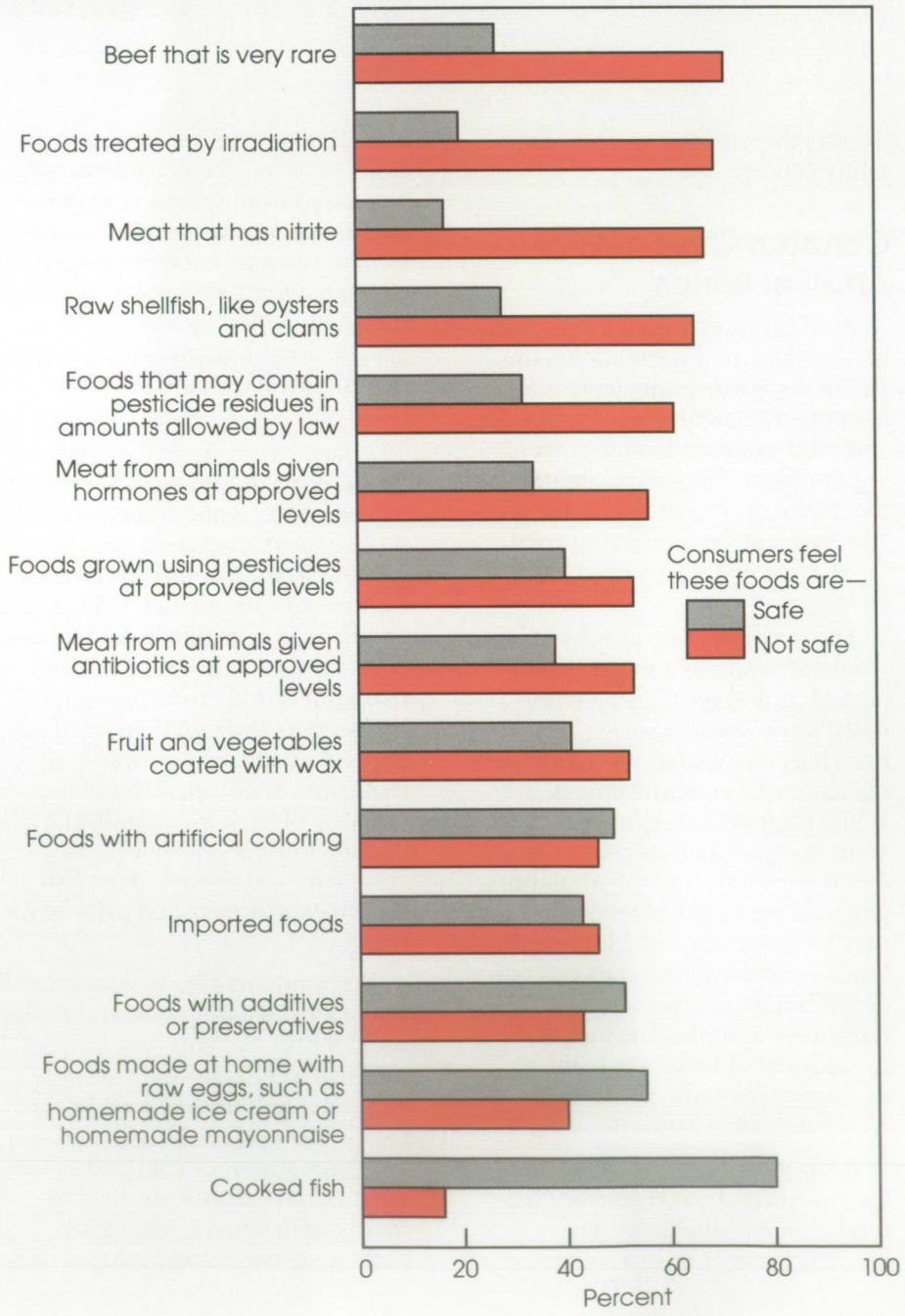
Food Production

The percentage of respondents who were concerned about specific food production and processing technologies varied.

For example, 43 percent indicated that foods containing additives or preservatives were not safe, and 46 percent believed foods with artificial coloring were not safe (fig. 1). Meat from animals given antibiotics or hormones at approved levels was viewed as unsafe by 53 and 56 percent of respondents, respectively. Sixty-seven percent felt that meat with nitrite was unsafe (nitrite is added to cured meats to improve flavor and color and serves as a food preservative). Fifty-two percent considered the waxing of fruit and vegetables to be unsafe (waxing is used mainly to enhance appearance and to retard spoilage and water loss, but also as a medium for applying fungicides). Sixty-nine percent of the respondents perceived irradiated foods as unsafe (irradiation is used to kill foodborne microbes, thereby improving product safety and shelf-life). Respondents were almost evenly split on the perceived safety of imported foods.

Figure 1

Respondents More Worried About Certain Foods and Practices Than Others



However, on certain food-safety issues—such as the use of nitrite, irradiation, hormones, and imports—some respondents appeared unable to judge whether or not a certain food or practice was safe. This is reflected in the relatively high percentage of respondents who said they "don't know" or did not provide answers. This observation suggests that some consumers may lack the necessary information to decide.

Respondents Question Pesticide Safety

A majority of respondents was concerned about the safety of pesticides. They were slightly more concerned about residues on food than about the use of pesticides in general.

The survey included two questions related to pesticides: one on pesticide use in general and one on pesticide residues left on food. The first asked respondents to judge the safety of foods grown using

pesticides at approved levels to control weeds and other pests. Over half (53 percent) said these foods were not safe; only 40 percent declared them safe (fig. 1). In the second question, a larger majority (61 percent) indicated that it was not safe to consume foods that may contain pesticide residues in the amounts allowed by law. Just under a third of the respondents viewed legal pesticide residues on food products as safe.

In a different series of questions, participants were asked how much they agreed or disagreed with three pesticide-related statements. Respondents expressed their opinion on a rating scale of 1 to 6, with 1 meaning strongly disagree and 6 being strongly agree (fig. 2).

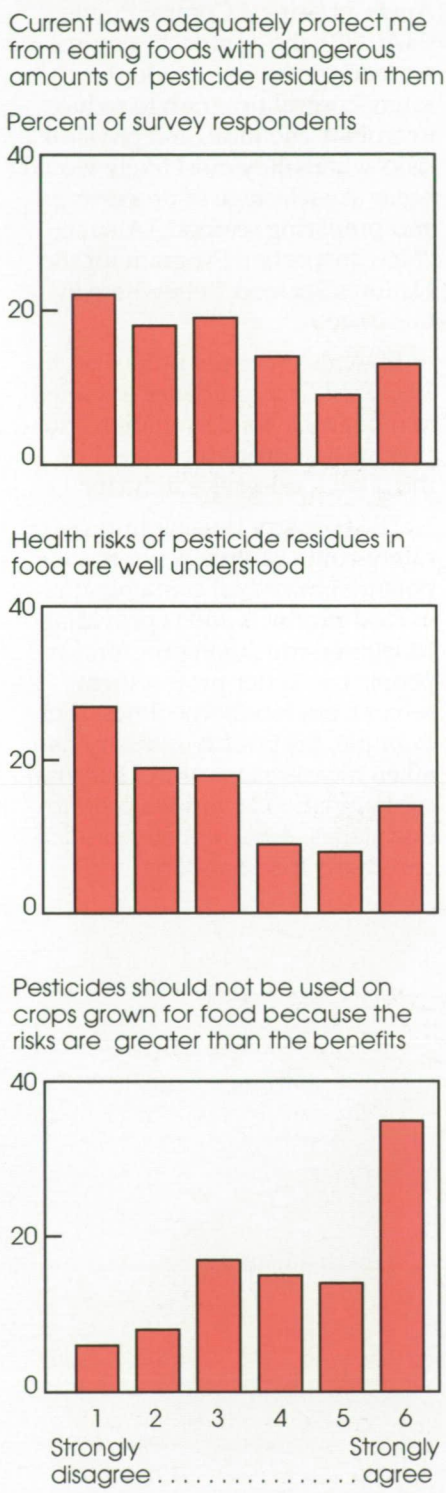
Respondents were not confident in pesticide regulations. Fifty-nine percent strongly to mildly disagreed (scale points 1-3) that "the current laws adequately protect me from eating foods with dangerous amounts of pesticide residues in them." Of the extremes, 22 percent strongly disagreed with that statement, while only 13 percent strongly agreed.

Respondents' uncertainty about health risks posed by pesticide use may reflect the difficulty in communicating risk information and the lack of consensus in the scientific community regarding the exact magnitude of health risks posed by pesticide use. Sixty-four percent strongly to mildly disagreed that the health risks from pesticide use were well understood. Only 14 percent strongly agreed, while 27 percent strongly disagreed.

A majority of respondents (64 percent) strongly to mildly agreed (scale points 4-6) that "pesticides should not be used on crops grown for food because the risks are greater than the benefits." Of the extremes, 35 percent strongly agreed that the risks are too large to justify use of pesticides in food production, while only 6 percent strongly disagreed.

Figure 2

Respondents Feel Unsure About Pesticides



Proposed Regulatory Reforms

One area of ambiguity in the discussion of food-safety concerns centers around whether people considered microbial contamination more serious than pesticide residues. Food-safety experts suggest that consumers are much more likely to get sick from foodborne microbial contamination than from pesticide residues. The DHKS and some other consumer surveys show that consumers felt more concerned about microbial contamination than about pesticide residues. The opposite result, however, also has been found in some surveys. Regardless of the overall ranking of specific consumer concerns about pesticides, these surveys strikingly reflect that the concerns were both broad and deep.

The widespread and persistent expression of consumer concerns about the safety of food and its production and processing, coupled with better scientific knowledge about the risks, have contributed to the momentum for reforming existing food-safety regulations. (See "New Approaches To Regulating Food Safety," elsewhere in this issue.)

For example, in late 1993, the Clinton Administration proposed a substantial overhaul of current food-safety legislation regarding pesticides. The proposal calls for a health-based risk standard for pesticide residues on fresh and processed foods. The reform legislation incorporates recommendations made by the National Academy of Sciences in its 1993 report *Pesticides in the Diets of Infants and Children* in order to ensure that the pesticide-registration process considers the unique aspects of children's diets and potential sensitivities to pesticide risks. New registration procedures will streamline the registration process for pesticide products

and will encourage the development of low-risk and minor-use products. The proposal also encourages the use of nonchemical agricultural practices and further promotes the use of integrated pest management (IPM) to reduce pesticide use.

In addition, USDA's Food Safety and Inspection Service (FSIS), the Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services, and the food industry are collaborating to minimize risks of foodborne illness from meat, poultry, and seafood. For example, current USDA inspection systems for meat and poultry are being improved from the traditional organoleptic (sight, smell, and touch) inspection approach toward an approach of controls founded on quantitative risk assessments at various production and processing stages. This change will add preventative measures to the inspection of final products.

Labels are now required by USDA on all uncooked meat and poultry products to provide consumers and foodservice industry employees with safe handling and cooking instructions.

FDA is proposing to improve the safety of the Nation's seafood supply by revamping seafood inspections. Known as Hazard Analysis Critical Control Points (HACCP), the approach requires seafood processors to adopt a safety-control program to reduce microbial, chemical, and physical risks where they most likely would occur at each stage of processing and preparing seafood. (Also see "New Inspection Program for the Nation's Seafood," elsewhere in this issue.)

FDA also recently published the *1993 Food Code*, guidance intended to modernize food sanitation and preparation procedures used by the retail foodservice industry.

The industry is using improved safety-control measures to reduce potential microbial contamination in food products and is providing consumer-education programs so people can better protect themselves from foodborne illness. For example, the poultry industry has taken measures to control bacterial contamination at various production stages. Also, industry-prepared safe food handling instructions about eggs, meat, and poultry are distributed on product packages and in supermarkets.

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Consumers Want Reduced Exposure to Pesticides on Food

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It is common to hear that the U.S. food supply is among the safest in the world. Yet, it is equally common to hear concerns expressed about it—particularly over microbial contamination, such as the much-publicized cases of *E. coli*-tainted hamburgers in the West, and pesticide residues, such as the scare over Alar pesticide on apples.

In a recent national survey by the University of Kentucky, primary household food shoppers revealed their opinions on food safety (fig. 1). Their top three concerns were fats and cholesterol (33.7 percent of respondents), bacterial food poisoning such as salmonellosis and botulism (30.0 percent), and pesticide residues on food (18.4 percent).

While previous consumer surveys have ranked pesticides as the top food-safety concern, the rankings in this survey reflect current scientific evidence which indicates that pesticides pose a lower risk to consumers than does microbial contamination.

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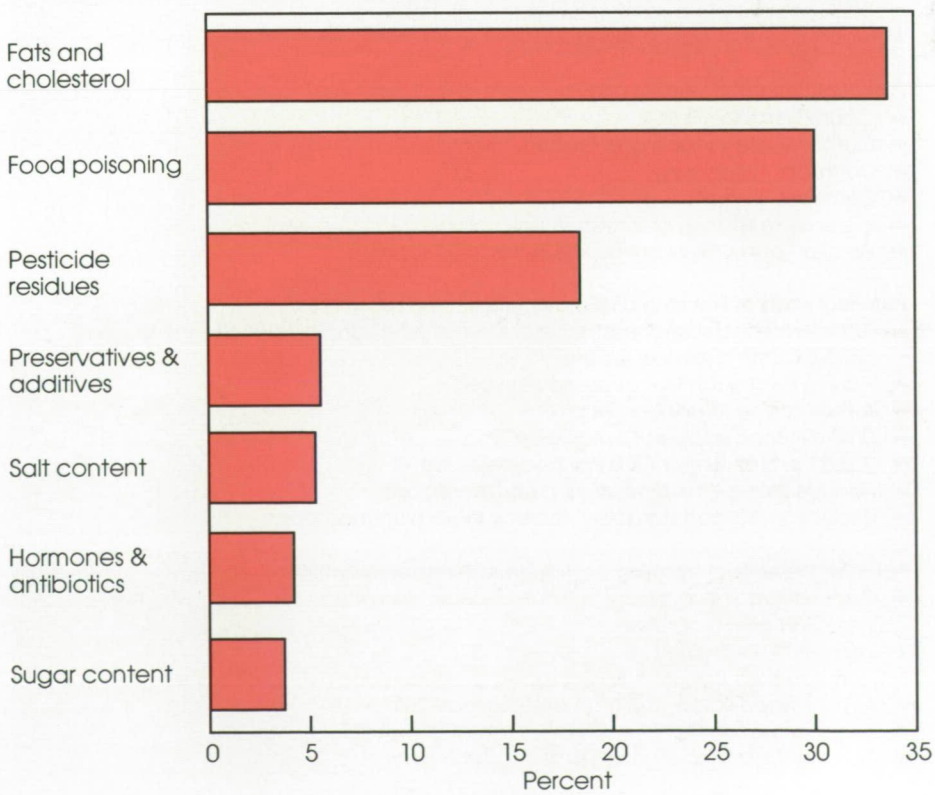
At Issue: Do the Costs Outweigh the Risks?

Pesticides used on crops are often considered effective, easy to use, and inexpensive. Nonchemical technologies, such as pest-resistant crop varieties and cold storage, can only do so much to protect agricultural products against pests and to prolong storage life. Many producers and handlers in the agricultural

Figure 1
Consumers Surveyed List Their Top Food-Safety Concerns



marketing chain use a combination of pesticides and nonchemical technologies.

Pesticide use also has several costs, mainly considered in three categories: environmental, worker, and food safety (table 1). Pressing environmental concerns about pesticide use include impacts on wildlife, increased soil erosion, and contamination of surfacewater and groundwater.

Worker safety is also an issue because many users are exposed to high levels of pesticides. Individuals who use pesticides are generally at a much higher risk of being harmed by pesticides than are consumers. Using gloves or respirators and following strict control practices can reduce worker exposure. Yet, these practices pose a burden to workers that Occupational Safety and Health Administration (OSHA) rulings have considered excessive in some factory settings.

Pesticides also pose food-safety risks to consumers. Consumers can take some preventive actions to reduce their exposure to pesticide residues, such as by washing, peeling, and cooking produce, or by purchasing products with lower risk (such as organic food products). Some consumers want more preventive action taken by the Government, such as bans, stricter regulations, and labeling.

Producers and other pesticide users (such as produce packinghouses) often rotate pesticides to help prevent build-up of pest resistance. If the Government bans effective pesticides, users may have to apply more of the less effective pesticides to do the same job. And if they have fewer pesticides to use, fungi, insects, and bacteria may more quickly develop resistance to the remaining pesticides. This means that banning some pesticides may make the remaining pesticides less effective which, in turn, may actually result in greater use of pesticides.

Table 1
Pesticide Use on Produce Carries Benefits and Costs

Potential benefits of pesticide use:
+ Decrease food costs
+ Enhance cosmetic appearance
+ Expand variety of foods marketed in any one location
+ Extend storage, transportation, and shelf-life
+ Help assure consistent year-round supply
+ Help meet the world's food supply needs
+ Improve food quality by preserving nutritional integrity
+ Reduce naturally occurring toxins
+ Stabilize and enhance crop yields
Potential costs of pesticide use:
− Cause harm to wildlife
− Contaminate surface and groundwater
− Decrease food safety
− Decrease worker safety
− Increase resistance of insects, fungi, and bacteria to pesticides
− Weaken consumer confidence in the food supply
Potential costs of banning pesticides with limited substitutes:
− Accelerate increased resistance of insects, fungi, and bacteria to the limited pesticides still available for use
− Add to total quantities of pesticides used
− Affect cosmetic appearance
− Limit distance shipped to market
− Raise costs for users of the banned pesticide(s)
− Reduce income for producers in certain regions
− Reduce yields and storability, thereby increasing food costs
Potential benefits of banning pesticides with limited substitutes:
+ Generate regional advantages by encouraging more production where there are fewer pest problems
+ Improve worker safety
+ Nonusers may benefit from increased produce prices without facing higher costs
+ Reduce food-safety risks from pesticide residues
+ Reduce risks to wildlife
+ Reduce surface and groundwater contamination

Survey Explores the Issues

In 1992, the University of Kentucky conducted a national survey of consumers' major food-safety concerns and the actions they take to reduce food-safety risks in fresh produce (see box for more details about the survey).

The survey also sought to find if food shoppers would pay more money to reduce their risks from pesticide residues, and if the amount they will pay would correspond to the level of risk reduction. This willingness-to-pay issue is represented by the amount respondents would spend for a grapefruit that has lower risks of pesticide exposure than a standard grapefruit.

The survey shows how demographics play a role in respondents' willingness to pay for food safety and ranks the factors they consider when deciding which fresh produce to buy.

Shoppers Relate Attitudes

Attitudes about pesticides varied widely, from 30 percent believing that the current levels of

pesticides were safe to 31 percent feeling that the Government should ban all pesticides. Sixty-two percent of the respondents said that in the past they had refused to buy certain fresh fruit and vegetables because of information presented by the media regarding harmful pesticide residues.

An overwhelming number (almost 90 percent) felt that all produce should be clearly labeled with information on pesticide use to allow them to make more informed purchasing decisions. Presently, most retail produce is not labeled with any pesticide information. Labels for nonorganic produce, printed on shipping cartons and containers, usually list pesticides used on the produce. However, such information is not included in supermarket displays, meaning shoppers do not have information about pesticides used.

A small proportion of produce is labeled as "organic" or "certified pesticide residue-free" (PRF).

Organic produce is grown using organic farming methods which do not use synthetic pesticides, growth regulators, or fertilizers. More than half the States have definitions for "organic" produce, but national standards required by the 1990 farm bill are still being developed.

PRF produce is grown conventionally, then tested and certified as free of pesticide residues.

Respondents to the survey believe in taking their own preventive actions to reduce their food-safety risks. Almost 90 percent said they regularly rinsed their fresh produce with water to avoid pesticide residues—and 18.6 percent washed fruit and vegetables with soap and water. Forty-seven percent said that they were wary of buying imported produce, but only 26.2 percent said that they regularly avoid buying it. Over 35 percent grew their own fresh produce to avoid pesticide residues.

Although over half the respondents preferred to buy organically grown fresh fruit and vegetables, only a quarter said they actually did so on a regular basis to reduce the risks from pesticides. Similarly, 50.7 percent said that they would pay more for produce that was certified as PRF, yet only 17.5 percent said they regularly purchase such produce.

A few reasons account for the big difference between what respondents said they would like and what they said they actually do. One reason is price—organic and PRF produce generally cost more than standard produce. Consumers may not be able to afford organic and PRF produce on a regular basis (increased awareness of pesticide risks could change how consumers allocate their household budgets). A second reason is availability—organic and PRF produce are not always available in all supermarkets. A third reason is cosmetic appearance. People may like the idea of organic produce because this practice helps protect the environment and reduce food-safety risks. Yet when it comes to buying it, consumers may choose the standard produce if it is more attractive.

Respondents ranked the importance of factors they consider when deciding which fresh fruit and vegetables to buy. Responses ranged from "not important" to "very important" (fig. 2). Of the very important issues, freshness/quality was cited the most frequently, with 27.2 percent of the

About the Survey

The effort consisted of a national phone survey, followed by a mail questionnaire. The phone survey provided the initial sample of primary food shoppers for the mail questionnaire and measured demographics—such as age, gender, race, household income, household size, and education—and attitudes about food safety. The study examined the relationship between household demographic characteristics and the amount of money that respondents would pay to reduce their risks from pesticides.

The phone survey completed interviews with 3,228 primary food shoppers who purchased fresh grapefruit for their households in the past year (a 65.3-percent response rate).

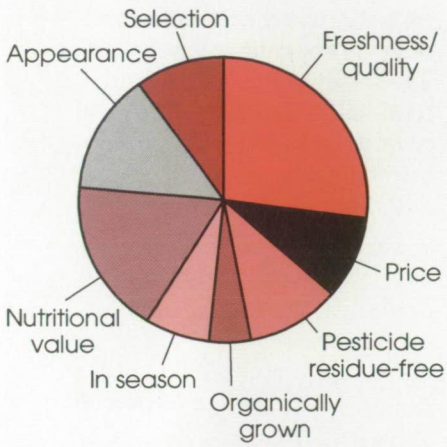
Although grapefruit is not necessarily riskier than other produce, grapefruit was selected as a representative crop for the food-safety scenario. Selection criteria included short storage intervals, low import levels, and distinct production areas.

Of those in the phone survey, 2,197 were willing to participate in the follow-up mail questionnaire. The mailing generated 1,671 completed surveys, giving a response of 76 percent.

The respondents were similar in profile to the U.S. population in terms of income, race, and education, but there were more women than men (and no children) in the sample. This proportion was expected, because women are more likely to be the primary food shoppers.

Figure 2

Freshness/Quality Cited Most Frequently as "Very Important" in Purchasing Decisions



Concerns cited as "very important" in deciding which fresh fruit and vegetables to buy

"very important" rankings (fig. 2). Other factors considered very important in selecting produce were nutritional value, product appearance, and certified PRF.

Almost 90 percent of the respondents who considered PRF as a very important factor also said the same of freshness/quality. Therefore, it is difficult to determine which of these two factors is more important to respondents.

Respondents Would Pay More To Lower Their Risk

The shoppers surveyed said they would be willing to pay more than the typical purchase price of grapefruit to reduce their risk from pesticide residues (see box). For example, respondents would pay, depending on the measurement method used, an average of between 15 and 69 cents above the 50-cent purchase price for a grapefruit to buy one with a lower risk from pesticide residues. Five percent said they would pay more than double the price of a fresh grapefruit to buy a safer one.

Respondents were presented with hypothetical 50-percent or 99-percent reductions in risk from eating fresh grapefruit. On average, those faced with the larger reduction in pesticide exposure from fresh grapefruit were willing to pay a few cents more than were those given the 50-percent scenario. This suggests that consumers in this sample were sensitive to the level of risk reduction.

In this survey, demographics play a role in consumers' willingness to pay. Younger respondents were willing to pay more for the risk reduction than were older respondents. Less educated people were willing to pay more than those with more schooling. Income, race, and household size had no apparent effect on whether respondents would pay more. Female respondents would pay more than male respondents would. Also, those voicing stronger opinions about pesticide residues were willing to pay more than were those with more neutral opinions.

Implications for Policy

If consumers want stricter pesticide regulations imposed, they will most likely have to share the increased costs to growers and other pesticide users, either directly through higher food prices or indirectly through higher taxes. Most consumers in this survey said they are willing to shoulder some of the extra cost in order to reduce their risk from pesticide residues in food.

Almost 90 percent of those responding to the survey thought that all produce should be clearly labeled to tell what pesticides were used. This implies strong support for national organic standards and labeling as well as support for listing the pesticides used on conventionally grown produce.

More information is needed on consumers' willingness to pay for different levels of risk reductions from pesticide residues and whether the amount consumers would pay would cover Government and industry costs of providing reduced pesticide residues. This information would help regulators decide whether to impose, and how to pay for, stricter pesticide laws or a larger role in certification and labeling of fresh produce.

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Some Barriers to Organic Produce at the Wholesale Level

Steven Payson, Biing-Hwan Lin, and Jane Wertz
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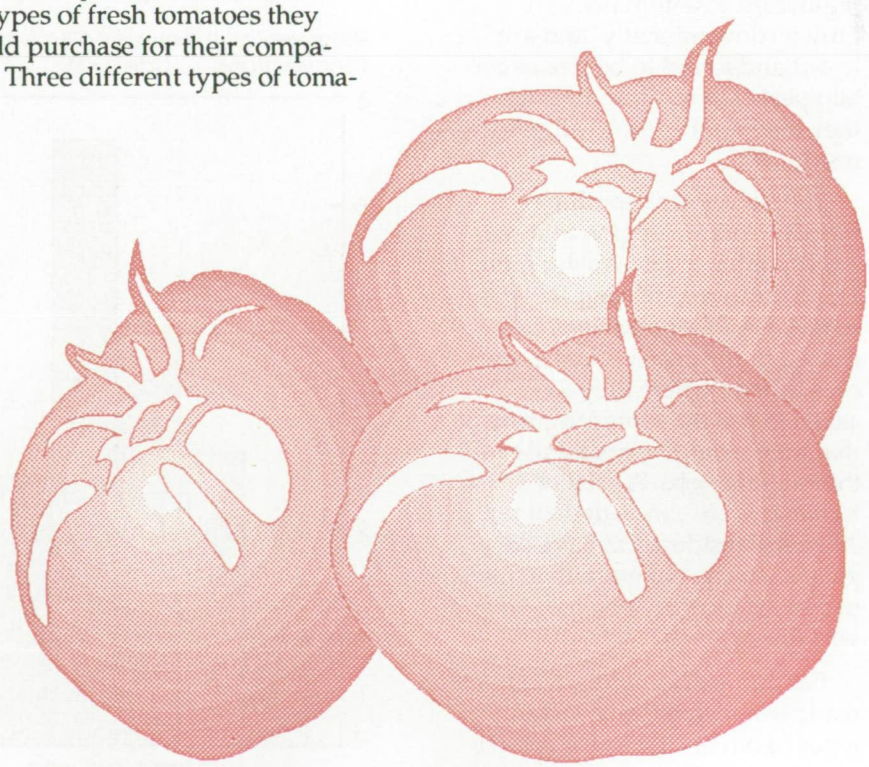
Why is only a small proportion of all produce organically grown? One important factor may be that farmers would grow it only if enough consumers are willing to pay a higher price to compensate for the higher production costs. However, as organic farming methods become more advanced and experienced organic farmers become more adept at increasing yields, the additional costs would likely come down.

But since surveys show that consumers state they are willing to pay significantly more for organic produce when it has the same cosmetic quality as conventionally grown produce, there could be other explanations for the small showing of organics in the food market. (See "Consumers Want Reduced Exposure to Pesticides on Food," in this issue for more on consumers' willingness to pay to reduce risks from pesticide residues.)

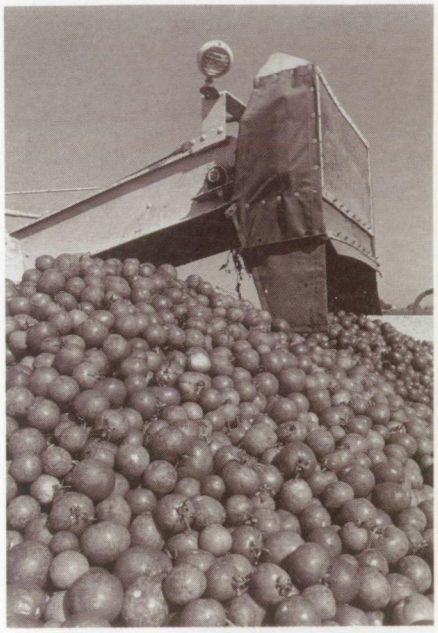
Some suspect that an important constraint on the growth of organics is a reluctance on the part of food companies to carry it. A recent survey of tomato handlers in the Mid-Atlantic region supports this belief.

Professional Buyers Reveal Their Preferences

Produce buyers for retail and wholesale companies were asked about their preferences for different types of fresh tomatoes they would purchase for their companies. Three different types of tomatoes were reviewed: conventionally grown, organic, and pesticide residue-free (called PRF). The vast majority of tomatoes are grown conventionally, in which a wide variety of fertilizers and pesticides are often used. Organic tomatoes are grown using organic farming methods which do not utilize synthetic



Payson and Lin are agricultural economists with the Resources and Technology Division, Economic Research Service (ERS), USDA, and Wertz is a former ERS employee.



Opinions of professional handlers could be an important constraint on the expansion of the organic produce market. Their top concerns: low demand, short supply, and high discard rates.

pesticides, fertilizers, or growth regulators. PRF tomatoes are grown conventionally, and are tested and found to be free of certain pesticide residues (though they may not be free of all pesticide residues).

The survey was conducted in the Mid-Atlantic region in three metropolitan areas: Washington, DC; Baltimore, MD; and Richmond, VA. Interviews were conducted in the professional buyers' own offices, where they were asked to use the same judgment that they would normally use in their regular jobs. A total of 33 interviews were conducted, of which 30 were considered to have complete answers. No more than one participant for any given company was surveyed.

For this article, comparisons are made between the answers of two types of buyers: those for companies that handle organic tomatoes but also may handle conventional tomatoes (called "organic" buyers), and those for companies that handle only conventionally grown tomatoes (referred to as "nonorganic" buyers). The 16 organic buyers surveyed had very different preferences from the 14 nonorganic buyers.

Price a Major Factor

As suspected, organic buyers were willing to pay a high premium for organic tomatoes (fig. 1). But surprisingly, nonorganic buyers would not pay as much for organic tomatoes as they would for conventionally grown tomatoes, even if the cosmetic quality and availability were the same. Organic buyers also were willing to pay more for PRF tomatoes than for conventional tomatoes, but not as much for PRF as for organic tomatoes. Nonorganic buyers, on the other hand, would pay about the same amount for PRF tomatoes as for conventional tomatoes.

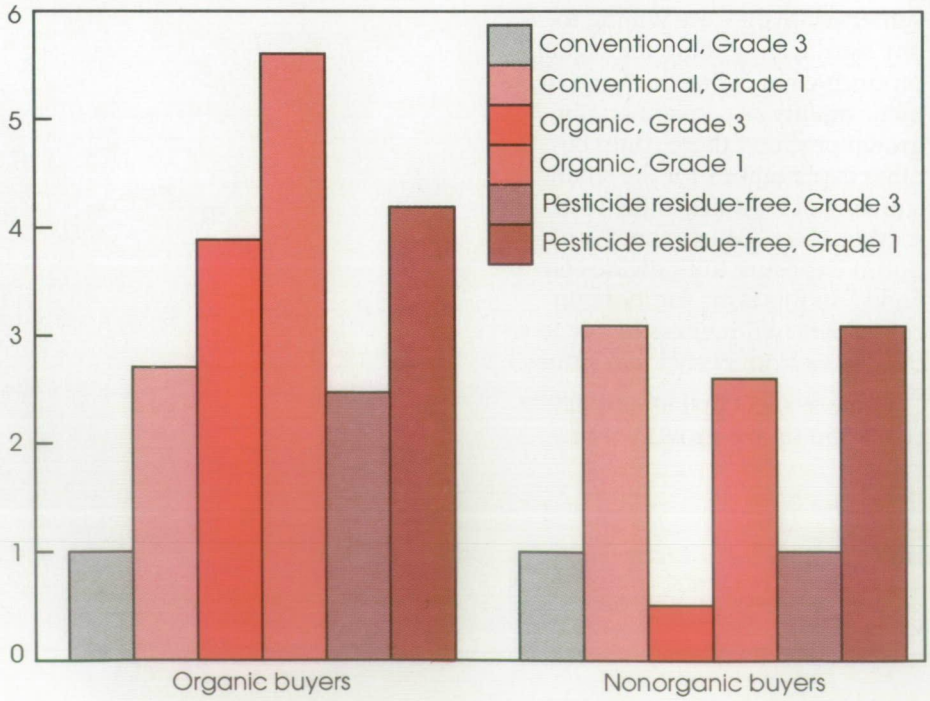
As expected, the buyers strongly preferred Grade 1 tomatoes over Grade 3 tomatoes, since Grade 1 tomatoes have much less damage or decay (see box on how grades were defined in the survey). Yet, organic buyers would spend nearly four times the price of Grade 3 conventional tomatoes to buy Grade 3 organic tomatoes. Nonorganic buyers would pay only about half the price of Grade 3 conventional tomatoes for Grade 3 organic tomatoes.

This difference between the two groups of professional buyers is less pronounced with regard to Grade 1 organic tomatoes, where there is a two-fold—rather than an eight-fold—difference. The differences in how the two types of buyers value PRF tomatoes mirror those differences observed for or-

Figure 1

"Organic" Buyers Would Pay Much More for Organic Tomatoes—"Nonorganic" Buyers Would Pay Much Less

Relative value perceived by different buyers for tomatoes (conventional Grade 3=1)



ganic tomatoes, although the gaps are much smaller.

Marketing Factors Cited as a Constraint

Produce buyers were asked questions about the relative importance of various marketing factors hindering the supply of organic and PRF produce. Organic and nonorganic buyers generally agreed on the relative importance of 13 out of 17 factors considered (fig. 2).

The two groups differed most when it came to perceived quality, with many of the nonorganic buyers citing inconsistent quality as a problem in the marketing of organic and PRF produce. Organic buyers did not see this as an important constraint.

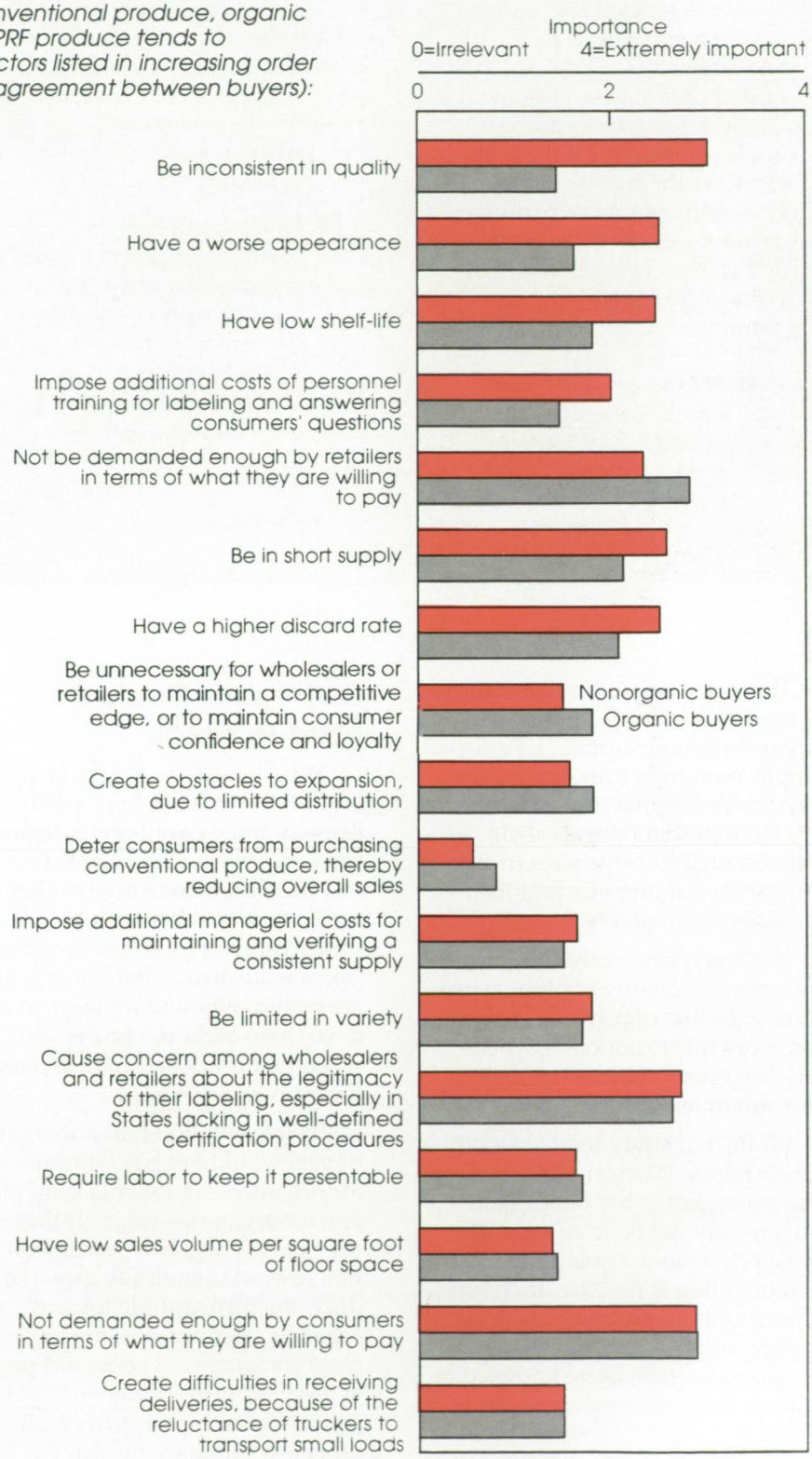
The other areas of disagreement involved whether organic and PRF produce have a worse appearance than conventional produce, have a lower shelf-life, or impose additional personnel costs. Of these, however, only the quality-consistency issue differed substantially (in terms of statistical significance) between the two groups of buyers.

Among the market constraints agreed upon by both groups, five were regarded as particularly important: low demand for organics by consumers, low demand by retailers, short supply, high discard rate (which could depend on both shelf-life and turnaround), and concern among retailers and wholesalers about the legitimacy of labeling (such as the reliability of the process by which produce is certified as organic). Of these, the last suggests a role for increased Government involvement in enacting and enforcing labeling and certification standards in organic and PRF markets. However, as national standards for organic certification become established, this last constraint would have less impact.

Figure 2

Suppliers' Opinions Limit the Market for Organic and Pesticide Residue-Free (PRF) Produce

Buyers feel that compared with conventional produce, organic or PRF produce tends to (factors listed in increasing order of agreement between buyers):



Grade 1 Versus Grade 3 Tomatoes

USDA's Agricultural Marketing Service establishes grades for the inspection of fresh fruit and vegetables. There are three grades of tomatoes (1-3), with Grade 1 being the highest in quality and Grade 3 the lowest. To make the survey manageable, participants were only asked about two grades—1 and 3. The main characteristics of these, as explained to the participants, are:

- For either Grade 1 or Grade 3, no more than 1 percent of all tomatoes can be soft or affected by decay.
- Grade 3 can be misshapen and slightly affected by sunscald, while Grade 1 can have no more than 15 percent of all tomatoes misshapen or affected by sunscald.
- Grade 3 can have no more than 5 percent that are very seriously damaged by insects, and no more than 10 percent seriously damaged by any other cause. Grade 1 can have no more than 5 percent that are very seriously damaged by any cause.

These results are similar to those obtained from other opinion surveys of produce suppliers. For example, one study found that nonorganic suppliers in New Jersey have stronger negative views than do organic buyers about the appearance of organics and their consistency in quality.

However, in a study comparing the cosmetic quality of organic produce with that of conventional produce, organic produce—particularly organic tomatoes—actually was not much different in quality.

While that study refers to a different region (Tucson, AZ), it nevertheless suggests that nonorganic buyers may not have an accurate perspective on the quality of organics. If that is the case, then such a perspective—and the prospects for organics—will likely change as suppliers become more knowledgeable.

Old Habits Could Be Hard To Break

Although organics may create higher costs to suppliers, partly because of things like higher discard rates, suppliers may be able to control these costs over time as they become more familiar with handling practices for organic produce. Suppliers who already handle organics are continually finding ways to reduce these additional costs and, when that is not possible, to pass them on to consumers.

The observation that nonorganic buyers would not pay a premium for organics—and would only pay less for organics—suggests that they have a negative predisposition toward organically grown produce. Such an attitude toward organics does not exist among most consumers, who would pay at least as much for organics as for conventional produce when all other attributes are the same.

Consequently, the negative view held by many nonorganic buyers in the survey toward organic produce implies that the current small size of the organic market in the Mid-Atlantic area is not due entirely to the preferences and buying practices of consumers. At present, the preferences of suppliers could be an important constraint on the marketing and expansion of organic and PRF produce.

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Milk and Biotechnology: Maintaining Safe, Adequate Milk Supplies

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Amid unparalleled coverage of the introduction of a new technology for milk production, the U.S. Food and Drug Administration (FDA) approved in late 1993 a synthetically produced hormone for cows—called recombinant bovine somatotropin, or rbST—for commercial sale in the United States.

Consumer-watch groups questioned the safety of milk and dairy products for human consumption from dairy cows receiving rbST, and some dairy suppliers and grocery stores indicated that they would not sell the products. Many want products made with milk from cows receiving rbST to carry labels.

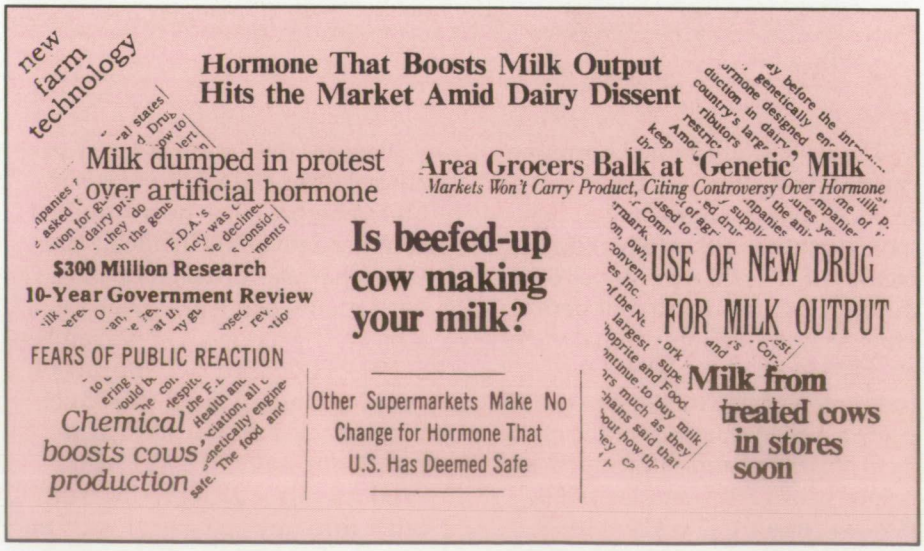
FDA, the Federal agency primarily responsible for determining the safety of new animal drugs and for labels on milk and dairy products, says these fears are unfounded. After considerable testing (the first study reporting results of rbST-supplementation of dairy cows was in 1982), they found rbST use to be safe to dairy cows and they found dairy products made with milk from treated cows to be safe for human consumption.

The FDA Commissioner, David A. Kessler, has stated,

> "This has been one of the most extensively studied animal drug products to be reviewed by the agency. The public can be confident that milk and meat from bST-treated cows is safe to consume."

The Biotechnology Hits the Market

rbST is an artificially synthesized copy of a naturally occurring protein hormone in cattle (called bovine somatotropin, or bST). The hormone is naturally secreted by a cow's pituitary gland, directing how energy and nutrients from feed are used for growth, milk production, and other body functions (see box).



Consumers, the dairy industry, and Federal budget watchers have expressed concerns about the ramifications of rbST use.

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rbST: Genetically Copied Hormone

rbST is an artificially synthesized copy of a naturally occurring protein hormone in cattle called bovine somatotropin, or bST. Four variants of natural bST, based on the number and location of amino acids, exist.

Hormones serve as chemical links between cells and organs within the body. bST is naturally secreted by a cow's pituitary gland, directing how energy and nutrients from feed are used for growth, milk production, and other body functions. The hormone is then transported in the cow's bloodstream to other organs, where its biological effects occur. For example, bST reaching the cow's udder stimulates the production of milk.

The sequence of amino acids comprising bST gives it a unique three-dimensional "shape." For bST to induce a biological effect in the cow, it first must bind with specific receptors on the cell membrane of tissues or body organs. These receptors have a three-dimensional shape that matches that of the bST.

Initial studies suggested that bST's only function was promoting growth—findings that led to its earlier identification as a bovine growth hormone (bGH). Later studies found that bST was an important metabolic hormone that also influenced body maintenance and milk production. Research has shown that the overall composition, manufacturing, and nutritional qualities of milk are unchanged in milk from cows receiving rbST.

The shape of rbST differs slightly from naturally produced bST in that some additional amino acids may be added to the end of the bST molecule during its manufacture. (There are some manufacturing processes that produce no extra amino acids.) The biologically active part of rbST is identical to the biologically active part of natural bST, regardless of the presence of the extra amino acids added during manufacturing.

The genetically copied hormone can be administered to dairy cows to boost milk production. Studies have reported milk production increases of 10 to 20 percent per cow during a 245-day treatment period. However, percentage estimates can be misleading, especially if the base levels of production are not reported. USDA analyses of the effects of rbST assume a production response of 1,800 pounds of milk per cow, or an 11.5-percent increase (based on a 1993 average output of 15,610 pounds per cow), over a 305-day lactation period.

Because rbST is considered an animal drug, FDA approval is required before it can be distributed commercially in the United States. Four pharmaceutical companies have been seeking approval for their rbST products. On November 5, 1993, FDA approved the sale of the Monsanto Company product (trade name Posilac). FDA's approval applied to the Monsanto product only—such products of other firms are being evaluated individually.

FDA's review procedures for animal drugs emphasize effectiveness and safety. Drugs to be used in food-producing animals must be determined safe to: 1) humans (from consumption of food products from animals receiving the drug or from administration of the drug product); 2) the animal receiving the drug; and 3) the environment.

Human Safety

FDA's findings on human safety of rbST are based on two sets of information: the general characteristics of bST and the results of studies (conducted in accordance with FDA rules and guidelines) by the firms offering the products.

The major human-safety issues raised to date are: 1) the safety of consuming milk and meat from cows receiving rbST, 2) risks related to insulin-like growth factors (IGF), and 3) risks associated with possibly greater antibiotic use.

Safe Milk and Meat

Based upon research indicating that rbST was not active in any species tested if given orally, plus the fact that bST was shown in the 1950's to be inactive in humans even if injected, FDA concluded early in the investigational period (mid-1980's) that milk and meat from test animals receiving rbST were safe for human consumption.

Several groups—including the American Medical Association, the National Institutes of Health, the Congressional Office of Technology Assessment, the World Health Organization, and the Food and Agriculture Organization of the United Nations—later supported FDA's findings.

Insulin-Like Growth Factors

Scientists raised concerns in the 1980's about the effect of rbST on levels of insulin-like growth factors (IGF) in milk. IGF's, in particular IGF-I, mediate many of the biological actions of somatotropins. Bovine IGF-I was found to be

identical in structure to human IGF-I. Therefore, scientists wanted to be sure that milk and meat from dairy cows receiving rbST would not enhance human IGF-I effects. Because there was limited information available, FDA requested more data from companies concerning the connection between rbST use and IGF-I levels and effects.

IGF-I levels in milk were found to vary widely among cows and herds. rbST use slightly raised IGF-I levels, but not beyond the ranges found in cows and herds not receiving the products.

It also was found that IGF-I in milk is biologically inactive when ingested through the mouth. IGF-I levels in milk from both test animals and animals not receiving the drug were 100 to 1,000 times below the level naturally occurring in human blood. Indeed, it has been shown that IGF-I is a natural protein required for normal growth and possibly health maintenance in humans. It is normally present in almost all human body tissues and fluids, including human breast milk and saliva. FDA concluded that the milk and meat from dairy cows receiving rbST presented "no increased health risk to consumers."

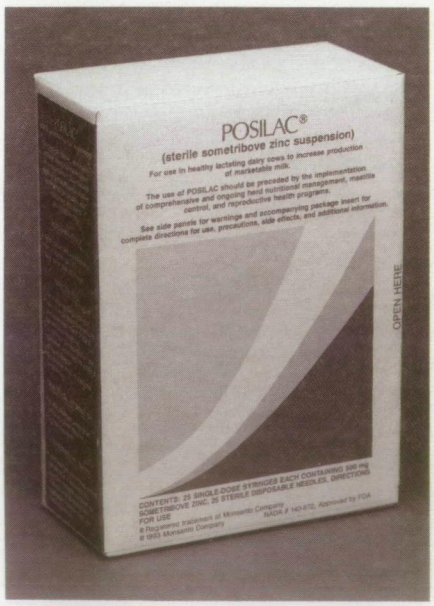
Antibiotic Usage

A 1992 U.S. General Accounting Office (GAO) report concluded that rbST could present an indirect risk through possible increases in the incidence of mastitis (an udder infection common among lactating dairy cows) and the expected increased use of antibiotics to treat the condition.

A fact often ignored in the controversy surrounding the use and safety of rbST is the existence of measures to prevent milk with unsafe levels of antibiotic residues from reaching the public. An extensive system of monitoring by both State and Federal agencies exists to detect residues of illegal drugs in milk. Farmers face severe financial penalties if they are found to have shipped milk containing these residues.

FDA reviewed the data provided by Monsanto to address the mastitis issue. The incidence of mastitis cases in test animals was slightly greater, but did not appear any more difficult to treat than mastitis in nontest animals. Also, the effect of Monsanto's rbST product on the incidence of mastitis was found to be substantially less than other factors, such as herd-to-herd variation, environment, season, age of the cow, and stage of lactation. FDA concluded that the human health risk posed by the potential increase in antibiotic use was not significant (FDA's findings apply to Monsanto's product only—other rbST products must be reviewed individually for their risks of clinical mastitis).

Monsanto voluntarily developed a program, in consultation with FDA, to monitor effects of its approved rbST product. The program includes: 1) evaluation of rbST use on small and large commercial dairy farms, focusing on the health of dairy cows, especially mastitis, animal drug use, and milk losses due to mastitis or drug treatment; 2) collection of information on farmer acceptability and any problems encountered; 3) a 2-year tracking of milk production and drug residues, and 4) a 1-year study of producer-supplied milk to compare the amounts discarded due to positive drug tests between rbST and non-rbST herds.



On November 5, 1993, FDA approved the sale of Posilac, Monsanto's rbST product.

The fact that rbST is a near exact copy of naturally occurring bST presents a significant regulatory issue. rbST is not detectable in dairy products because current scientific procedures cannot easily differentiate between the artificial rbST and the natural bST. It should be noted that a test method to determine whether milk or meat was derived from rbST-treated cows was not required by FDA; such regulatory methods are not required for animal drug products for which there are no human food-safety concerns. The "no residue" standard employed by FDA to evaluate animal drug safety becomes an issue in itself when such differentiation is not possible.

Consumers Want Labeling

Surveys show consumers overwhelmingly desire special labeling of milk products from cows receiving rbST products. FDA held an open joint meeting of its Food Advisory and Veterinary Medicine Committees in May 1993 to consider the labeling issue. Interested parties were invited to present testimony and make statements.

Sound scientific evidence must exist for FDA to make mandatory labeling decisions—consumer preferences alone are not sufficient. With input from the advisory committees plus the testimony provided at the May meeting, FDA

concluded that it had no legal basis under the Federal Food, Drug, and Cosmetic Act, as amended, for mandating special labeling of products processed or manufactured of the milk from cows receiving rbST. This decision was announced November 5, 1993.

FDA has ruled that food companies could voluntarily label milk and dairy products with respect to rbST, provided the information is "truthful and not misleading." An interim guideline was published in February 1994 by FDA concerning such labeling, but no final decisions have yet been made public. Many consumer and industry groups and individuals have sent in comments regarding the labeling guidelines. FDA must evaluate these comments prior to making a final decision.

Economic Ramifications

Consumers, the dairy industry, and Federal budget watchers share concerns about the economic ramifications of rbST use. The effects of rbST on milk production and prices received by dairy farmers, the subsequent impacts on retail prices for milk and milk products, and the effect these changes will have on Federal outlays for dairy support and domestic food assistance programs are just some of the issues raised.

Milk Production Will Rise Slightly

Since the product has just recently become commercially available, economic analyses have depended on the assumptions of analysts.

A recent study, based in part on USDA analyses, indicated a 1-percent average annual increase in U.S. milk production due to rbST use over fiscal years 1994-99. Prices farmers receive for their milk would decline by about 2 percent per year over the study period, which pushes down total dairy income by about 1 percent per year.

These estimates presume: a continuation of current USDA milk price-support policies, an 1,800-pound-per-cow increase in milk production due to rbST and the appropriate change in feeding to support that increase, an adoption rate by producers resulting in 34 percent of the cows receiving rbST by fiscal year 1999, and no reduced consumption of milk and dairy products once rbST milk is marketed more widely.

Greater milk production would cause prices for farmers to fall and lead to more dairy product purchases by the Federal Government to support farmers' incomes. Federal dairy price-support program costs would increase, peaking at approximately $150 million in fiscal 1996, and then would decline in later years as the industry adjusts to rbST use. This would represent a 1.8-percent increase in the total projected Federal farm commodity subsidies in fiscal 1996. The projected increase in dairy price-support program costs over the entire fiscal 1994-99 period of $510 million represents about 1 percent of Federal farm commodity subsidies for that period.

At the same time, however, lower milk prices would lower the Government's cost of providing fluid milk, cheese, and infant formula to participants in the Special Supplemental Food Program for Women, Infants, and Children (WIC). Lower fluid milk prices would also lower the cost of the Government's Thrifty Food Plan, the basis for calculating food stamp benefits.

Savings in the costs of Federal food assistance programs would begin in fiscal 1997, averaging $18 million per year for WIC and $53 million per year for food stamps over fiscal 1997-99. These savings could completely offset increases in dairy price-support program costs within 10 years.

rbST Expected To Be "Size Neutral"

One concern raised is whether rbSt will force small dairy farmers out of business. Analysts generally characterize rbST as a "size neutral" technology. That is, on the basis of cost per cow, farmers with small herds will benefit as much as farmers with larger herds if managerial ability is equal.

No significant capital or equipment expenditures are required to use rbST. For example, Monsanto has offered rbST in a 25-dose package for $140. Such small-dose availability means no dairy farmer should be precluded from using rbST on the basis of herd size. On a per-cow basis, with a 215-day treatment period, the cost of rbST would amount to $86, or 40 cents per day of treatment.

However, if rbST is heavily adopted and milk prices are reduced, at least some of the smaller farmers that do not use rbST might be forced out of the dairy business, because they would not be producing economically sufficient volumes of milk. This situation would arise with other cost-saving technologies, too.

But Will Consumers Buy It?

Surveys have shown a generally positive outlook on agricultural biotechnology by consumers. However, surveys of milk consumers have shown a wide range of reaction to rbST use. The consumption issues related to rbST are fundamentally concerned with fluid milk, which represents about 40 percent of total milk use. Rennet, a bioengineered protein hormone which has been in use in cheese production since 1990, has raised few concerns to date.

Prior to rbST approval, it had been reported that anywhere from 4 to 20 percent of consumers said they would stop buying milk altogether if rbST were approved and used. Translated into sales, these results suggest a 2- to 8-percent decline in total milk demand. However, fluid milk sales actually strengthened in early 1994 and have had the first sustained growth since 1991.

Concerns raised by consumers regarding rbST are similar to issues that have been raised for other foods. Biotechnology in agricultural production is a sensitive issue. The availability of clear, concise information to both farmers and consumers will play a major role in the acceptance of rbST.

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New Inspection Program for the Nation's Seafood

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Earlier this year, the U.S. Food and Drug Administration (FDA) announced a groundbreaking initiative to further ensure the safety of the Nation's seafood. Known as Hazard Analysis Critical Control Points (HACCP), the plan requires seafood processors to adopt a program that identifies potential food-safety hazards and adopt controls specifically targeted to those hazards to prevent them from occurring or at least to minimize the likelihood of their occurrence.

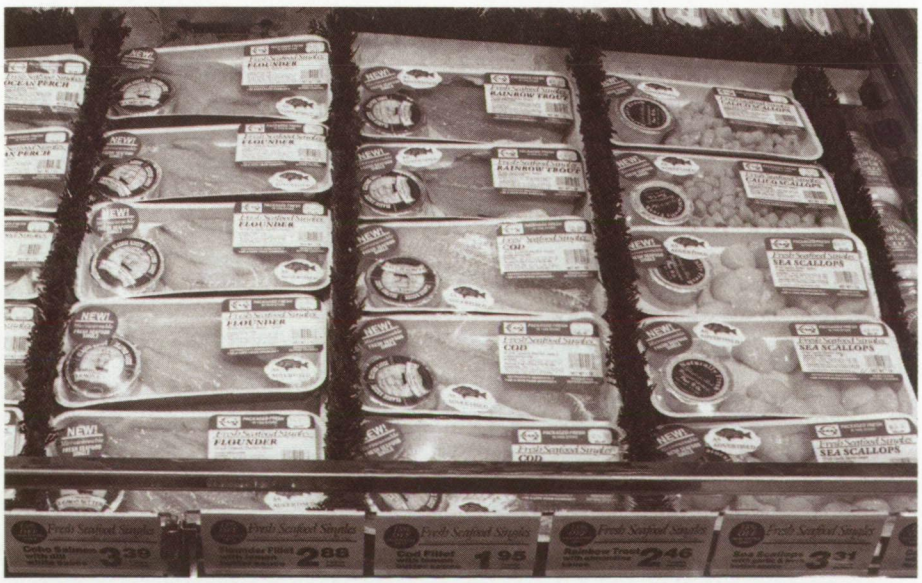
HACCP focuses on prevention of product contamination rather than on detection of contaminated products. Verification that HACCP is in place and is working would be an added feature of FDA's current system of periodic mandatory inspections of processing plants to produce a more effective system of ensuring the safety of seafood. FDA expects to finalize the rule in early 1995. The proposed rule, published for public comment on January 28, 1994, proposed an effective date of 1 year from the issuance of the final rule.

Williams is Chief of the Economics Branch and Zorn is an economist with the Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration.

Ensuring a Safer Supply

In 1992, per capita consumption of seafood was 14.7 pounds, down from its peak of 16.1 pounds in 1987. This decrease is due partly to changes in the relative prices of seafood, red meats, and poultry. Some consumer concerns about seafood safety may also be a factor.

There are numerous types of foodborne illnesses caused by seafood, ranging from the very severe bacterium, *Vibrio vulnificus*, which kills one out of every two people it infects, to the very mild illness Neurotoxic Shellfish Poisoning. Seafood contaminants include bacteria, viruses, natural toxins, parasites, and chemical contaminants. Control of some of these hazards (such as ciguatera) relies primarily on harvest management, whereas other hazards (such as scombro-



Nearly 5,000 U.S. seafood manufacturers—those that fillet, bread, and can fish and other seafoods—would be affected by the proposed rule. The rules would also apply to 2,400 packers, re-packers, wholesalers, and U.S. importers, as well as all foreign companies providing seafood to U.S. consumers.

toxin) are either introduced or may be controlled by manufacturers, retailers, or consumers.

Molluscan shellfish, such as clams, oysters, and mussels, which are served raw or partially cooked, present the greatest risk of likelihood of illness to consumers. These shellfish concentrate environmental contaminants and microorganisms in their flesh.

Only about 33,000 of the estimated 6.5 million to 33 million cases of foodborne illnesses that occur each year in this country are estimated to be attributed to seafood, representing less than half of 1 percent of the total. However, if seafood consumption increases, so will exposure to risks from seafood-carried diseases.

Monitoring Commercial Distribution, Step by Step

FDA estimates that Federal, State, and local authorities collectively spend about $100 million each year on the regulation of seafood. Regulatory agencies have relied primarily on testing the final products and inspecting processing plants. However, only a small number of samples can reasonably be tested relative to the number of seafood products and processors. Thus, both Government and businesses have begun to examine new methods and technologies and their potential for reducing foodborne illness in ways that are both workable and economically feasible.

HACCP is a preventive system of hazard control designed to minimize contamination of the product at all points in the production chain, including under-refrigeration and insufficient cooking times.

Initially developed by the Pillsbury Company in the early 1960's to provide safe food for U.S. astronauts in space, HACCP's step-by-step process of contamination prevention has been refined and adapted to commercial processing. It is not a "zero-risk" system, but it is designed to reduce the risk of food-safety hazards to a minimum.

In the 1970's, FDA mandated HACCP-type principles for canned fruit and vegetables that are not highly acidic. Several large U.S. food firms use HACCP-type systems in their plants. Canada has adopted HACCP for its seafood industry, and the European Union has stated its intention to adopt HACCP for seafood.

HACCP consists of seven steps. Under FDA's proposal, seafood processors must:

- Identify the likely health hazards to consumers in a given product
- Identify the critical control points (CCP's) in the production process where a failure of control is likely to introduce or intensify the risk of contamination
- Establish safety measures to prevent a hazard from occurring
- Monitor the system to ensure that the safety measures are working
- Establish the appropriate remedy if monitoring shows a problem
- Establish detailed recordkeeping to document the monitoring, the steps taken to prevent the hazards, and the remedies taken
- Verify that the control system is working (both the company and the Government would be involved at this step)

FDA's seafood HACCP proposal is based on these seven principles.

Imports Also Subject to HACCP

As the world's second largest seafood importer, the United States purchases 55 percent of its supply of edible seafood from some 135 countries, amounting to nearly $6 billion. Many of these imports come from developing countries that may not have the same level of seafood inspection as the United States.

HACCP would better ensure the safety of imported products. FDA now physically inspects a small percentage of imported seafood. Under FDA's new proposal, domestic importers of seafood will be required to have a HACCP plan of their own and to obtain HACCP plans from their foreign suppliers. Importers will also have to take affirmative steps to ensure that their suppliers are in compliance with HACCP. The proposal offers several ways to meet this requirement, including inspecting overseas plants, obtaining certification of foreign inspections, or testing the end product. This requirement would be deemed to be met if the importer's foreign supplier is located in a country that has entered into a mutual recognition agreement (MRA) for seafood with the United States. An MRA would establish that the foreign country has in place a mandatory, HACCP-based safety system equivalent to the U.S. system.

Initial Implementation the Largest Cost

FDA estimates that nearly 5,000 domestic seafood manufacturing plants would be affected by the proposed rule. Seafood manufacturers include companies that fillet, bread, and can fish and other seafoods. The rules would also apply to 2,400 packers, re-packers, wholesalers, and U.S. importers, as well as all foreign companies providing seafood to U.S. consumers.

The proposal does not specifically include aquaculturalists, fishing vessels, transporters, retail stores, or restaurants. However, many of these businesses would also be affected through buyer-seller relationships, that is, through restrictions that manufacturers will place on businesses in order to control hazards, such as by specifying to suppliers and distributors that the fish be properly refrigerated.

HACCP is primarily a fixed-cost system (the costs of the control program do not vary significantly with the amount of product produced). But costs do vary from plant to plant, based in part on risk and complexity. The more complex the processing system, the more CCP's that may have to be monitored.

Ideally, firms will adjust the frequency of monitoring to the likely frequency of failure of a CCP. Thus, the HACCP system should create incentives for firms to invest in more reliable equipment.

The fixed nature of HACCP costs will cause a relatively larger burden for small plants. Thus, firms with smaller sales over which to spread the cost of HACCP will likely shift away from production systems that have numerous CCP's. For example, a small seafood manufacturer may remove ready-to-eat shrimp cocktail from its product line. Whether this shift occurs may well depend on the condition of the plant. Plants that already have controls in place will find HACCP to be less of a burden than firms that do not.

Firms face costs in both developing a system and maintaining it. For purposes of estimating industry implementation costs, FDA acquired, through trade associations, some limited data from firms that have implemented HACCP. FDA economists also adapted a cost study performed for the National Oceanic and Atmospheric Administration (NOAA), which had previously conceived of a similar plan for seafood manufacturers. For the latter study, 130 manufacturing plants were examined for information on sanitation practices, processing controls, and recordkeeping.

The data based on actual implementation range from $2,000 to $20,000 per year. (A comparison of compliance costs to small firm profits may help put this in perspective. The average small seafood processor has annual sales revenues of about $250,000. At an estimated 3-percent return on sales, the average small processor has a profit of $7,500.)

The costs based on the NOAA modeling tended to be higher. More data are needed to reconcile these differences. Until such data become available, FDA's estimates must be considered tentative.

FDA estimates that total first-year costs for monitoring and testing equipment, training, operational changes, and other adjustments needed to implement a HACCP program would average $24,000 for small plants and $23,400 for large plants. Costs are larger for the average small plant because unlike many larger seafood manufacturing plants, many smaller plants do not currently have HACCP-type controls in place. Costs of this proposed Federal program include only new, mandatory expenditures.

Recurring charges for operating a HACCP program in subsequent years would cost small plants $14,700 a year, large plants $15,700 a year. Both initial and recurring costs of the HACCP program will vary for individual plants, based on the level of HACCP controls already in place.

In FDA's analysis, small plants are defined as those with annual sales of less than $1 million and large plants are those with annual sales of $1 million or more. Three-quarters of U.S. seafood manufacturing plants fall into that "small" definition (table 1). These manufacturers account for 7 percent of total industry sales.

Table 1
Three-Quarters of U.S. Seafood Manufacturing Plants Have Annual Sales Below $1 Million

Plant sales	Number of plants	Share of plants	Volume of industry sales
Million dollars	*Number*	*Percent*	*Percent*
Under 1	3,586	74	7
1-9.9	984	20	25
10-49.9	237	5	35
50-99.9	24	**	13
100 or more	15	**	20
Total	4,846	100	100

Note: **Under 1 percent.

Under a HACCP-type program explored by NOAA, 334 small firms could have gone out of business if the program had become mandatory, according to the work performed for NOAA. When Canada instituted its HACCP program in 1993, 2 percent of seafood processors closed. Small plants may be forced to close because they cannot spread the costs of compliance over their output as easily as large plants could. However, FDA asked for comment in its proposed rule on ways to mitigate the impact of the final rule on small businesses, such as allowing a longer time for them to comply.

According to FDA's preliminary estimate, total costs of the HACCP system for domestic seafood manufacturers would be $116 million in the first year and $65 million annually thereafter. Costs to foreign processors were estimated to be $96 million in the first year and $44 million in succeeding years. The costs will be passed on to consumers in the form of higher prices.

Benefits of HACCP

The primary benefits of the proposed rule are from reductions in foodborne illnesses (see table 2). For hazards which usually occur from mishandling seafood during harvesting or processing—such as scombroid poisoning (a generally mild disease that requires no medical care)—HACCP will greatly reduce health risks. FDA estimates that between 6,500 and 19,000 cases of seafood-caused illnesses, or in some cases deaths, could be averted under the HACCP program each year at a value of between $15 million and $75 million per year.

Some risks from seafood are not addressed by HACCP. For example, the program will not reduce any cases of Neurotoxic Shellfish Poisoning because the disease is primarily associated with products caught in recreational fishing—not commercial harvesting.

Consumers and the seafood industry should also benefit from increased confidence in the safety of seafood. Increased consumer confidence could boost demand for seafood. However, higher prices as a result of HACCP will mitigate this effect, so the change in consumption remains uncertain.

The higher demand for seafood could provide health benefits as people substitute seafood for protein sources with higher fat contents. For example, FDA estimates that if Americans increased consumption of fish by 1 and 5 pounds per person per year, the incidence of death would be reduced by 673 and 2,782, respectively, from coronary heart disease and cancer over a 10-year period. This results in benefits valued at $3 billion and $14 billion, respectively, over a 10-year period.

The Vice President's plan for reinventing Government has included consideration of HACCP for the entire food supply. With seafood as the first step, both FDA and USDA are currently examining the feasibility and desirability of HACCP for all other foods.

For More Information...

This article is adapted from FDA's preliminary regulatory impact analysis of the HACCP seafood proposal. The report details FDA's preliminary estimates of the costs of the proposed HACCP program for different types of seafood manufacturing plants and the methodology used in calculating the public-health benefits. Copies of the full analysis are available upon request to the authors. ■

Table 2
Hazards Associated With Seafood Consumption

Hazard	Annual cases prior to HACCP	Cases to be averted under HACCP
	Number	
Bacteria:		
Campylobacter jejuni	200	100-150
Clostridium botulinum	4	0-1
Clostridium perfringens	70	53-70
Salmonella, nontyphi	200	100-150
Shigella	70	18-35
Vibrio vulnificus	48	0-24
Other *Vibrios*	10,000	1,000-5,000
Natural toxins:		
Ciguatera	800	50-200
Neurotoxic shellfish poisoning	48	0
Paralytic shellfish poisoning	13	0
Scombrotoxin	7,960	3,980-5,970
Parasites:		
Anisakis	100	10-75
Diphyllobothrium latum	1,000	250-750
Giardia	30	0-8
Viruses:		
Hepatitis A	92	15-46
Norwalk	12,400	1,000-6,200
Total	33,035	6,576-18,679

American Eating Habits Changing: Part 2

Grains, Vegetables, Fruit, and Sugars

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While diets are changing, a considerable gap remains between public health recommendations and consumers' practices. USDA Consumption Surveys indicate that Americans have shifted to a lower fat, higher carbohydrate diet in the past decade. While we are eating more grains, especially in mixtures, we still are not eating the amounts of high-fiber foods, including whole-grain products, legumes, vegetables, and fruit, that are recommended in the latest dietary guidance.

And, we eat more foods that contain large amounts of refined sugars. In fact, about two-fifths of the total carbohydrates available in the U.S. food supply comes from sugars added to foods and beverages. White bread is by far the favorite bread, and sweet baked goods (such as cookies and cakes) are very popular. Sugared soft drinks are consumed in large amounts. Alcoholic beverages also contribute many calories to the diet.

This is the second article of a two-part series which uses U.S. per capita food supply data (called disappearance—see box for more details), to gauge how our eating patterns are changing over time. The data are compiled annually by USDA's Economic Research Service. The nutritive value of the foods is estimated by USDA's Agricultural Research Service. This article focuses on grain products, legumes, vegetables, fruit, caloric sweeteners, and beverages. (See "American Eating Habits Changing, Part I: Meat Dairy, and Fats and Oils" in the September-December 1993 *FoodReview* for information on consumption of animal products.)

Nutritionists are very concerned that people are eating too many new manufactured foods that are

Sugar is, in a sense, the number-one food additive. It turns up in some unlikely places, such as pizza, bread, hot dogs, boxed rice mix, soup, crackers, spaghetti sauce, lunch meat, canned vegetables, fruit drinks, flavored yogurt, ketchup, salad dressing, mayonnaise, and some peanut butter.

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About the U.S. Food Supply Data

Patterns of food consumption have changed significantly in the United States since 1909, when USDA began to collect data on the food supply. These data represent the amount of foods, excluding alcohol, that disappear into domestic markets. While not actual consumption data, the numbers reflect changes in overall patterns of food use by the population over time. Between 1909 and 1990, for example, the proportion of calories available in the food supply from fats increased from 32 to 40 percent, the percentage from carbohydrates declined from 57 to 49 percent, and the percentage from protein remained unchanged at 11 percent.

USDA's Economic Research Service (ERS) annually calculates the amount of food available for human consumption in the United States. The U.S. Food Supply Series is the only historical series on food and nutrient availability in the country.

The total food supply is based on records of commodity flows from production to end uses. Total available supply is the sum of production, beginning inventories, and imports. For most commodities, measurable uses are exports, industrial uses, farm inputs (seed and feed), and year-end inventories. Human food use is normally not directly measured or statistically estimated. The availability of food for human use is, therefore, a residual component after subtracting other uses from the available total supply. In a few cases, food supplies are measured directly and one of the other use components becomes the residual category. This is the case for wheat, in which flour production is measurable and livestock feed becomes the residual.

The availability of food for human use represents disappearance of food into the marketing system. Hence, it is often referred to as food disappearance. Per capita food "consumption" or "use" usually is calculated by dividing total food disappearance by the U.S. total population. The food disappearance estimates measure supplies moving through trade channels for domestic consumption. However, because most foods are perishable, changes in disappearance presumably are associated with changes in actual consumption.

Food disappearance is often used to estimate human consumption. Used in this manner, the data usually provide an upper bound on the amount of food available for consumption. Estimates can overstate actual consumption because they include food that is discarded in processing, lost in spoilage, thrown away at home, or fed to pets.

Estimates of the nutrient availability of the food supply are derived from data on quantities of foods available for consumption per capita per year and from data on the nutrient composition of foods. USDA's Agricultural Research Service (ARS) annually estimates daily levels of food energy (calories) and 24 nutrients and food components in the U.S. food supply.

More details on ERS's food consumption series and ARS's nutrient availability series can be found in *Food Consumption, Prices, and Expenditures (SB-867)*. An electronic database also is available. Call toll-free, 1-800-999-6779, for ordering information.

low fat or nonfat but are high in sugar and calories and low in fiber. Whole-grain products, legumes, vegetables, and whole fruit that are high in vitamins, minerals, and especially fiber and that contain little added sugar are consumed in relatively low amounts, as compared to more processed foods that are stripped of fiber (such as fruit juices and drinks, white rice, and refined-flour products).

Between 1977-78 and 1989-91, the average intake of carbohydrates increased from 43 percent of total energy (calorie) intake to 49 percent, according to USDA surveys. In a diet providing 2,000 calories, this would translate to about 245 grams of carbohydrates. (Average fat intake declined between the two survey periods from 40 percent of total calories to 34 percent, still well above the 30-percent maximum recommended.)

A variety of sources, including the American Cancer Society and the American Heart Association, recommend that the carbohydrate content of the diet be increased to 55 to 60 percent of the total energy intake. The *Dietary Guidelines for Americans* recommend choosing a diet with plenty of vegetables, fruit, and grain products. Most dietary carbohydrates should be from complex carbohydrates, with some from naturally occurring simple

carbohydrates such as those found in fruit, vegetables, and milk. Refined sugars should be consumed only in moderation. An increase in dietary fiber above the current intake of about 12 grams per day is also recommended. An expert committee of the Life Sciences Research Office of the Federation of American Societies for Experimental Biology recommends 10 to 13 grams of fiber per 1,000 calories, or about 20 to 35 grams of fiber (roughly double the current intake) for the average healthy adult.

These references have been used to establish the Daily Reference Values (or Daily Values on food labels) for total carbohydrates and for fiber. The Daily Reference Value for total carbohydrates is calculated as 60 percent of calories, or 300 grams in a 2,000-calorie diet. The Daily Reference Value for fiber is based on a recommended intake of 10 to 13 grams per 1,000 calories or about 25 grams in a 2,000-calorie diet.

The *Dietary Guidelines for Americans* and the Food Guide Pyramid provide the basis for consumer education programs carried out by USDA and the U.S. Department of Health and Human Services, as well as by The American Dietetic Association and the American Heart Association. The Pyramid suggests 2-4 servings of fruit, 3-5 servings of vegetables, and 6-11 servings of grain products, including several servings of whole-grain products a day as well as frequent use of legumes as meat alternates or as starchy vegetables.

A number of recent surveys have identified fat as a nutrient of major concern to consumers. By contrast, concern about fiber in the diet remains low. To follow general recommendations to eat less fat and to eat more fiber, people need to better understand what the major food sources of these components are and how their present diet fits in.

Information is critical. The new nutrition label required on almost all processed foods in 1994 is a powerful tool to help give interested Americans the information they need to make healthful food choices. To help consumers get the most from the new food label, Government and industry are mounting a multiyear food labeling education campaign to increase consumer's knowledge and effective use of the new food label and to assist them in making accurate and sound dietary choices in accordance with the *Dietary Guidelines for Americans*. More and more industry groups use the Food Guide Pyramid to show how their product can fit into a healthful diet. Companies are also providing time-pressed meal preparers—a growing number of whom lack the know-how of basic food preparation—with fast and convenient recipes and menus that are more healthful than the traditional fare.

An increase in the availability of a wide variety of appealing foods that help consumers meet dietary recommendations is also crucial. Mandatory nutrition labeling and the availability of new technologies and ingredients are spurring the development and marketing of alternative products of higher nutritional quality. Yet successful implementation of dietary recommendations will require that consumers have greater access to health-promoting foods on those occasions when they eat out—particularly considering that meals and snacks away from home captured 46 percent of the U.S. food dollar in 1993 and accounted for 35 percent of total food.

Grain Products

Consumption of grain products has risen in recent years, after falling dramatically from the levels of the first half of the century. Per capita use of flour and cereal products was 187 pounds in 1992, compared with an annual average of 146 pounds in 1980-83, 135 pounds in 1970-74, 181 pounds in 1945-49, and 287 pounds in 1910-15 (see table 1). The expansion in grain supplies reflects ample stocks and strong consumer demand.

Table 1
With Consumption Up 28 Percent, Grains Have Become One of the Most Popular Foods

Item	Annual average			Change, 1980-83 to 1992
	1980-83	1991	1992	
	Pounds per capita[1]			*Percent*[2]
Flour and cereal products	146.3	185.6	187.0	27.8
Wheat flour	116.8	136.6	138.1	18.2
Durum flour[3]	6.3	10.9	13.3	111.0
Rye flour	.7	.6	.6	-9.0
Rice (milled basis)	10.5	16.8	16.9	61.0
Corn products[3]	13.7	21.9	21.9	60.1
Oat products[4]	3.6	8.6	8.5	134.9
Barley products[5]	1.0	.9	.9	-12.8

Notes: Totals may not add due to rounding. [1]Consumption of most items reflects supplies at the processing level. [2]Excludes quantities used in alcoholic beverages, corn sweeteners, industrial uses, and fuel. [3]Semolina and durum flour in products such as macaroni, spaghetti, and noodles. Calculated from unrounded data. [4]Corn flour, meal, hominy, grits, and starch. [5]Rolled oats, ready-to-eat cereals, oat flour, and oat bran. [6]Barley flour, pearl barley, barley malt, and malt extract used in food processing.

The "Whole" (Wheat) Story: Check the Label

Consumers must read the label: just because a bread is brown in color or contains wheat flour does not mean it is truly whole wheat. The type of flour present in the largest amount is listed first on the ingredient label. Sometimes a dark color is provided by "caramel coloring," which is also listed on the label.

By law, bread that is labeled "whole wheat" must be made from 100 percent whole-wheat flour. Not to be confused with whole-wheat bread, "wheat bread" may be made from varying proportions of whole-wheat flour and enriched white flour.

The milling of wheat to produce white flour results in the loss of nutrients as the bran and the germ are removed. While it is true that some of the nutrients (iron, niacin, thiamin, and riboflavin) lost in the milling process are replaced when white flour is enriched, the flour remains low in fiber as well as some trace elements such as zinc and copper.

The Nutrition Facts section of the food label provides information about how much dietary fiber is in a product and how it fits into the recommendations for an overall daily diet. Foods that contain 20 percent or more of the Daily Value for fiber per serving can state on the label that they are "high in dietary fiber." Products containing 10 to 19 percent of the Daily Value can state that they are "a good source of dietary fiber."

Food labels may also carry health claims related to fiber and chronic disease risk. Foods that contain at least 2.5 grams of fiber per serving and are low in fat may claim to reduce the risk of cancer.

Much of this growth was product-driven, as consumers gained appreciation for variety breads, hamburgers and other products made with buns sold through a rapidly expanding fast-food industry, and a proliferation of a broad range of products with ethnic origins. The expansion of instore baking and other shifts in the retail marketplace offering more products also spurred this growth in grain-based foods.

Consumption of these foods benefits from an older population. In 1991, for example, households headed by someone aged 45 years or older spent an average of 23 percent more per person for cereals and bakery products than did younger households. Demand for flour and cereal products might be expected to rise in the 1990's, since the first of the baby boom generation, the largest U.S. population group, reached age 45 in 1991—if the aging boomers follow their predecessors' path.

Wheat is the major grain eaten in the United States, with wheat flour and other products representing 74 percent of total grain consumption in 1992. However, wheat's share of total grain consumption declined 6 percentage points since 1980-83, as consumption of rice, corn, and oat products has gained momentum.

Consumption of wheat flour in 1992 was 138 pounds per person, up 18 percent from 1980-83. Consumption of durum wheat flour (mainly used in pasta) rose 111 percent from 1984 (the first year for which data are available) to 13 pounds per person in 1992.

Other cereal products increased as well. Per capita consumption of corn products (corn flour, cornmeal, hominy, grits, and starch) increased 60 percent since 1980-83 to 22 pounds per capita in 1992. Per capita use of rice and oat products (rolled oats, ready-to-eat cereals, oat flour, and oat bran) climbed 61 percent and 135 percent, respectively, from 1980-83 to 1992. In contrast, consumption of rye flour and barley products (barley flour, pearl barley, and barley malt and malt extract used in food processing) continued to decline.

Despite the 28-percent increase in per capita grain consumption from 1980-83 to 1992, average grain consumption still falls below recommended levels. One reason is that many people still think that starchy foods, such as bread and potatoes, are fattening. In fact, most calories come from the company they keep—calorie-rich additions, such as butter or margarine, sour cream, gravy, and jam or jelly. Starches provide only about 4 calories per gram, while fat provides about 9 calories per gram. There appears to be a gap in understanding that on a diet low in fat, a greater proportion of the calories must come from complex carbohydrates. It appears that the public does not understand that 6 servings from the bread and cereal food group represent just over 25 percent of

the day's total on a 1,600 calorie diet.

Several nationwide surveys of consumer knowledge, attitudes, and behavior conducted in 1993 help explain the gap between dietary guidance and consumer practices. A study sponsored by the Food Marketing Institute (FMI) and *Prevention* magazine found that more consumers are using nutrition labels in making food selections, with 61 percent indicating they consistently use labels for first-time purchases. Only one in four consistently consider the information about carbohydrates or fiber, however. Just 5 percent of the shoppers knew that 6 to 11 servings of bread and cereals are recommended in the Food Guide Pyramid, and only one in three knew that fiber intake should be between 20 and 35 grams per day. FMI's annual TRENDS study of American shoppers indicates that concern about fiber in the diet has changed little since 1985, never climbing above 5 percent of the population.

In a study of dietary habits conducted for the American Dietetic Association (ADA), only 15 percent of Americans age 25 years and over mentioned eating more grains, cereal, or fiber to achieve a more healthful diet. The FMI/*Prevention* study found that while 58 percent of shoppers had made major changes in their diets for health reasons during the past 3 years, only 14 percent reported eating more fiber.

Whole grains—except in the form of flour—may be something of a mystery to many Americans. While most people are familiar with brown rice and oatmeal, other whole grains such as cracked wheat, barley, kasha, quinoa, and bulgur may sound unfamiliar. Whole grains are products that contain the entire grain, or all the grain that is edible. They include the bran and germ portions which contain most of the fiber, vitamins, and minerals, as well as the starchy endosperm. The natural oils in the bran and the germ tend to spoil quickly, especially in warm environments. This is why whole grains tend to be more costly, and one reason why most grains are refined in the first place—to increase their shelf-life.

Fruit and Vegetables

Americans increased their consumption of fruit and vegetables roughly 10 percent in the past decade (tables 2 and 3). On a farm-weight basis, vegetables accounted for most of the increase. Consumers bought more fresh produce, frozen and dried fruit and vegetables, and canned tomatoes and fruit, and less fruit juice. However, weather disruptions of production and a lackluster economy dampened sales in 1991 and 1992.

Markets for fresh fruit and vegetables have become increasingly global, as improved refrigeration and transportation have made it possible to expand supply sources. This increase has expanded the variety and seasonal availability of fresh fruit and vegetables to U.S. consumers.

The growing influence of the U.S. Hispanic and Asian populations is creating demand for oriental vegetables, tropical produce, chili peppers, and other specialties such as tomatillos (a Mexican fruit—often used in salsas—whose flesh is similar to that of a green tomato) and jicamas (a Mexican root vegetable used primarily in salads). For example, U.S. per capita consumption of chili peppers more than doubled between 1980 and 1992, from 3.3 to 7.2 pounds annually. That brings U.S. consumption

Table 2
Per Capita Use of Commercial Vegetables Rose Nearly 17 Percent

Item	Annual average			Change, 1980-83 to 1992
	1980-83	1991	1992	
	Pounds per capita			*Percent* [1]
Vegetables (farm weight)	335.1	388.6	391.7	16.9
Fresh	147.4	161.9	169.1	14.7
Potatoes	48.5	46.4	48.9	.9
Other	98.9	115.5	120.2	21.5
Processed	181.3	218.5	214.7	18.4
Canned	97.2	112.8	110.7	13.9
Tomatoes	61.0	77.4	73.8	21.0
Other	36.3	35.4	36.9	1.8
Frozen	55.5	73.1	71.9	29.5
Potatoes	38.7	51.3	51.0	31.9
Other	16.9	21.8	20.9	24.0
Other[2]	28.4	32.5	32.1	14.9
Pulses[3]	6.4	8.1	7.9	23.9
Vegetables (retail weight):				
Fresh potatoes	46.5	44.6	47.0	.9
Frozen potatoes	19.3	25.6	25.5	32.0

Notes: Totals may not add due to rounding. Excludes produce from home gardens. [1]Calculated from unrounded data. [2]Potatoes and onions for chips, shoestrings, and dehydrating. [3]Dry edible beans, peas, and lentils.

of chili peppers (based on fresh-weight availability) higher than many traditional vegetables—including broccoli, cauliflower, peas, and spinach.

As concern about consumption of fat and calories has grown, food manufacturers, restaurateurs, and consumers have turned to vegetables, fruit, spices, and herbs to add zest to lowfat foods and meals. Per capita consumption of onions, garlic, lemons, limes, mushrooms, mustards, dried capsicum peppers, and fresh-cut herbs increased dramatically in the past decade.

Grocers are giving more space and attention to the fresh produce section. Today's medium-size grocery stores carry an average of over 300 produce items, compared with 150 in 1980 and 64 in 1970.

Restaurant salad bars, introduced in the mid- to late 1970's, grew so popular that fast-food chains and supermarkets jumped on the bandwagon. For example, Burger King started with salad bars in 1983 and then switched to prepackaged salads in 1988 to accommodate the increasing drive-thru traffic. McDonald's began offering prepackaged salads in 1986. Most supermarket chain stores added salad bars during 1982-84, often adjacent to the service deli. Most now also offer a wide array of prepared salads.

Consumption of fresh fruit rose 15 percent above the 1980-83 annual average to 121 pounds (retail weight) per person in 1992 (table 3). The rise was due entirely to sharp increases in fresh noncitrus fruit and melons. Americans' favorite fresh fruit is bananas (27 pounds per capita in 1992), followed by apples (19 pounds), watermelons (14 pounds), oranges (13 pounds), cantaloupes (9 pounds), and grapes (7 pounds).

Severe freezes in Florida and Texas in December 1989 and in California in December 1990 caused sharp drops in production and consumption of citrus juice since 1990 and in citrus fruit since 1991.

Per capita consumption of fresh and processed apples—particularly apple juice—has trended upward since 1980, but consumption remains highly variable across products. While per capita consumption of canned apples has remained fairly flat over the last decade, that of apple juice has increased dramatically—surpassing consumption of fresh apples (on a farm-weight basis) in 5 of the last 10 years. In 1992, apple juice accounted for 41 percent of total U.S. apple consumption, at 19.9 pounds (farm weight) per person.

Per capita consumption of fresh-market grapes has increased 80 percent since 1980, from 4.0 to 7.2 pounds annually. Factors behind this strong growth are increased domestic production of seedless grapes; better postharvest handling, which has improved the quality of grapes reaching consumers; lower relative prices; and extended seasonal availability, with large imports from Chile from December to May.

The combined per capita consumption of 19 major commercial fresh vegetables in 1992 was 17 per-

Table 3
Noncitrus Items and Melons Push Up Fresh Fruit Consumption

Item	Annual average			Change, 1980-83 to 1992
	1980-83	1991	1992	
	Pounds per capita			*Percent* [1]
Fruit (farm weight)	259	265	263	1.4
Fresh	106	113	123	15.3
For processing	153	152	140	-8.2
Fruit (retail weight)				
Fresh	104.6	111.0	120.6	15.2
Citrus	25.2	19.0	24.3	-3.5
Oranges	13.3	8.5	12.9	-3.4
Noncitrus	61.5	70.8	74.4	21.0
Apples	18.0	18.3	19.4	7.2
Bananas	21.5	25.1	27.3	26.7
Grapes	4.8	7.3	7.2	48.2
Melons	17.9	21.2	21.8	22.0
Canned[2]	13.7	12.3	14.4	5.4
Frozen	3.0	3.9	4.7	57.4
Dried	2.5	3.1	3.2	28.6
Juice[3]	63.4	63.8	59.6	-6.0
Citrus	51.3	45.6	42.6	-17.0
Orange	44.0	40.7	38.0	-13.6
Other	7.4	4.9	4.6	-37.1
Apple	9.0	15.1	13.2	46.9
Grape	2.3	2.8	3.5	52.4
Prune	.8	.3	.3	-66.7

Notes: Totals may not add due to rounding. Excludes produce from home gardens. [1]Calculated from unrounded data. [2]Excludes berries, cranberries, and pineapples. [3]Data unavailable for pineapple, cranberry, and other juices.

Carbohydrates in the Food Supply Increased in 1990 Over 1980

Analysis of the nutrient content of the U.S. food supply by USDA's Agricultural Research Service indicates increases in per capita consumption of starches (up 20 percent) and sugars (up 5 percent) between 1980 and 1990.

The daily level of per capita food energy in the food supply increased from roughly 3,400 calories in 1980 to 3,700 calories in 1990. This 9-percent increase reflects higher levels of all three energy-yielding nutrients: carbohydrates, fat, and protein. The proportion of calories from carbohydrates increased from 47 to 49 percent, while the share from fat decreased from 42 to 40 percent. Protein has consistently accounted for about 11 percent of calories.

The daily per capita amount of carbohydrates in the food supply increased 12 percent between 1980 and 1990, from 404 grams to 452 grams. Most of the increase in the early 1980's is due to increased use of high-fructose corn syrup. Greater demand for grains—primarily wheat flour, rice, and corn products—is mostly responsible for the increase in carbohydrates in the late 1980's. (These food supply estimates include carbohydrates that are lost or discarded as waste and are thus higher than estimates of actual intakes.)

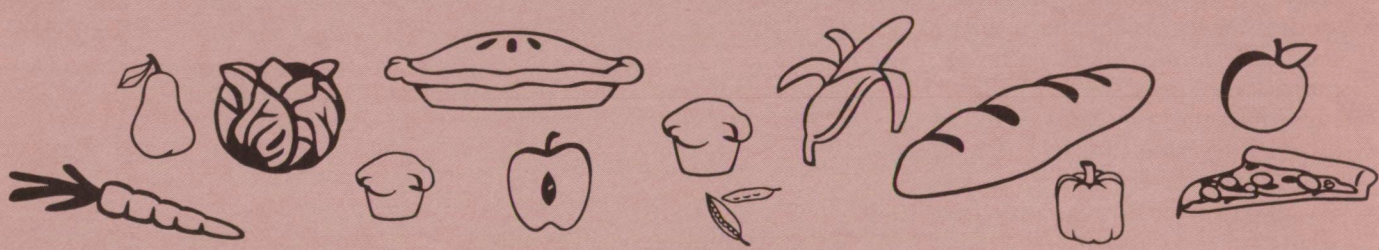
The daily per capita amount of starches increased from 185 grams to 223 grams, while the amount of sugars rose from 219 grams to 229 grams.

Food groups contributing carbohydrates in the food supply have shifted. For example, grain products contributed 40 percent of the total carbohydrates in the food supply in 1990, up from 36 percent in 1980. The proportion of total carbohydrates from added refined sugars declined to 38 percent in 1990 from 41 percent in 1980. The shares of total carbohydrates from vegetables, fruit, and dairy products also declined during the 1980's.

Grain products contributed 80 percent of starches in the 1990 food supply; vegetables, 14 percent; legumes, nuts, and soy, 4 percent; and miscellaneous items, 2 percent.

Refined and processed sugars added to foods and beverages contributed 75 percent of the total sugars available in the 1990 food supply; fruit, 12 percent; dairy products, 10 percent; and vegetables, 3 percent.

Information on the amount of dietary fiber available in the food supply is not available.



cent above the annual average for 1980-83 (table 2). Consumption of tomatoes used for canning also increased 21 percent, reflecting the popularity of prepared tomato-based salsa, picante, taco, pizza, and spaghetti sauces. However, per capita consumption of other vegetables used for canning remained flat during the past 12 years, as consumers substituted fresh and frozen for canned.

Americans consumed an average of 25.5 pounds of frozen potato products (retail weight) per person in 1992, a 32-percent increase from an average 19 pounds annually per person in 1980-83. In 1992, one-third of all potatoes grown in the United States was processed into frozen products—mainly french fries—due to demand from restaurants and other eating places. In 1991, about 87 percent of frozen french fries—4.8 billion pounds—was sold by the foodservice industry.

Concern about nutrition, the rising popularity of restaurants specializing in Mexican and East Indian cuisine, and interest over the past decade in ethnic foods are bringing beans and other legumes back into the American culinary mainstream. Dry bean, pea, and lentil use averaged 6.4 pounds per person a year during 1980-83 and

Per Capita Levels of Carbohydrates: Sugars and Starches in the U.S. Food Supply, 1980 and 1990

Item	Total carbohydrates[1]				Starches				Sugars			
	Grams per day		Percent of total		Grams per day		Percent of total		Grams per day		Percent of total	
	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990
From all sources[1]	404.1	452.4	100.0	100.0	185.5	223.1	100.0	100.0	218.6	229.3	100.0	100.0
Starches	185.5	223.1	45.9	49.3	185.5	223.1	100.0	100.0	—	—	—	—
Sugars[2]	218.6	229.3	54.1	50.7	—	—	—	—	218.6	229.3	100.0	100.0
Naturally occurring[2]	54.5	56.4	13.5	12.5	—	—	—	—	54.5	56.4	24.9	24.6
Added refined[2]	164.0	172.9	40.6	38.2	—	—	—	—	164.0	172.9	75.1	75.4
Meat, poultry, and fish	.4	.4	.1	.1	.4	.4	.2	.2	—	—	—	—
Eggs	.5	.4	.1	.1	—	—	—	—	.5	.4	.2	.2
Dairy (excluding butter)	22.5	22.8	5.6	5.0	—	—	—	—	22.5	22.8	10.3	9.9
Beverage milks	14.7	13.8	3.6	3.1	—	—	—	—	14.7	13.8	6.7	6.0
Other	7.8	9.0	2.0	1.9	—	—	—	—	7.8	9.0	3.6	3.9
Fats and oils	—	—	—	—	—	—	—	—	—	—	—	—
Sugar and sweeteners[2]	164.0	172.9	40.6	38.2	—	—	—	—	164.0	172.9	75.1	75.4
Fruit	26.2	27.5	6.5	6.1	—	—	—	—	26.2	27.5	12.0	12.0
Vegetables	36.7	37.6	9.1	8.3	31.3	31.9	16.9	14.3	5.4	5.7	2.5	2.5
White potatoes	19.1	19.9	4.7	4.4	19.1	19.9	10.3	8.9	—	—	—	—
Tomatoes	4.5	4.6	1.1	1.0	—	—	—	—	4.5	4.6	2.1	2.0
Legumes, nuts, and soy	7.2	8.0	1.8	1.8	7.2	8.0	3.9	3.6	—	—	—	—
Grains	143.4	178.7	35.5	39.5	143.4	178.7	77.3	80.1	—	—	—	—
Miscellaneous items[3]	3.2	4.1	.8	.9	3.2	4.1	1.7	1.8	—	—	—	—

Notes: Totals may not add due to rounding. — = Less than 0.05. [1]Excludes dietary fiber, which is a carbohydrate that cannot be digested in the human stomach and small intestine, and thus provides little energy. [2]Sugars and sweeteners include sugars in manufactured foods, such as ice cream, canned fruit in syrup, sweet baked goods, and soft drinks, and sugars in such forms as table sugar and honey. The sugars shown for other categories refer to sugars that occur naturally in the specified commodity. For example, the sugar for dairy refers to lactose, the sugar that occurs naturally in milk. [3]Includes coffee, tea, herbs, spices, and chocolate liquor, which is what remains after cocoa beans have been hulled and roasted. Source: USDA's Agricultural Research Service.

then jumped 26 percent to 7.9 pounds by 1992.

Despite the gains in the popularity and availability of fruit and vegetables in the past decade, consumption remains well below the levels recommended by Government and health authorities. USDA food intake surveys in 1989-90 indicate that more than a fourth of the population ate no fruit and drank no fruit juice during the 3 consecutive days of recordkeeping. A larger proportion of low-income people (33 percent) ate no fruit than did high-income people (23 percent). Total fruit and vegetable intake generally increased with age. Only about 25 percent of individuals ate legumes in the 3-day period of the survey.

Prices explain some of the problem. Between 1980 and 1992, retail prices more than doubled (up 109 percent) for fresh produce and rose 62 percent for processed fruit and vegetables. In comparison, prices rose 81 percent for cereal and bakery products, 47 percent for sugar and sweets, 41 percent for dairy products, 41 percent for red meat and poultry, and 22 percent for eggs. Disruptions in production due to the vagaries of weather, coupled with strong consumer demand since the mid-1980's, lie behind higher retail prices for fresh produce, which tend to be sticky on the downside.

Another part of the problem is lack of consumer awareness of the importance of consuming recommended amounts. To increase consumers' knowledge, the National Cancer Institute (NCI) is sponsoring "5-a-Day for Better Health"—the first nationwide health promotion to focus on the positive role of fruit and vegetable consumption in reducing the risk of cancer and other chronic diseases. The promotion is designed to be an active partnership between NCI, the produce industry, Government agencies, and health professionals.

Results from NCI surveys show that 5-a-Day and the Food Guide Pyramid are making headway. In 1993, 29 percent of Americans knew they should eat at least five servings of fruit and vegetables daily, compared with 22 percent in 1992 and only 8 percent in 1991.

Another factor behind the low consumption is consumers' desire for convenience. A trend toward drive-thru, carryout, and home-delivered meals has served to squash the salad bar popularity of the 1980's at many fast-food places.

Industry is responding to the challenge of adding convenience to the produce department with a host of new products and services. Carrots, celery, broccoli, cauliflower, salad mixes, pineapples, citrus, and melons—a whole variety of fresh products—are now being washed, peeled, cored, cut, and otherwise prepared and then packaged so consumers can just pick them up at their retail outlet, open the package, and use. Mixtures ready for stirfrying or microwaving save time and usually come with preparation instructions. Fresh, whole peeled onions and potatoes—which are vacuum-packed to retain freshness and color—are already popular in food service and soon to come to grocery stores.

Such items—convenient for snacks and lunchboxes—are snapped up by time-pressed consumers who are willing to pay more for the ease. Fresh-cut baby carrots and salad mixes typically cost double the price of the traditional (commodity) carrots and lettuce. Yet, these value-added newcomers have not hurt sales of commodity carrots and lettuce. Some consumers continue to use iceberg and leaf lettuces as a salad staple, adding salad mixes (the newer ones include a variety of fresh herbs) to make the salad more interesting. According to Information Resources Inc. (a research firm which tracks supermarket sales of bar-coded items), packaged fresh-cut salad mixes (including coleslaw mixes) accounted for $323 million in sales in 1993, a 93-percent increase in sales in 1 year.

Value-added products (such as fresh-cut items and salad mixes) are estimated by the industry to account for roughly 5 percent of retail produce sales in the United States. The trend is stronger in some parts of the country—California, for example—than in others. Among retailers polled by *Supermarket News*, reported sales ranged from 2 to 3 percent to 15 percent. But many analysts think that a vigorous move to better storage, handling, and display of value-added produce—in refrigerated cases that maintain the optimum 32- to 34-degree temperatures—could boost sales as high as 25 percent by the end of the decade.

The new nutrition label is a powerful tool to help give interested Americans the information they need to make healthful food choices.

Processed vegetable products also offer consumers considerable time savings. In 1993, for example, Contadina introduced canned pasta-ready tomatoes for an instant sauce or ingredient. VegAll Stir Fry and Recipe vegetables come frozen in varieties and sizes for adding to recipes.

Caloric and Low-Calorie Sweeteners

Americans have become conspicuous consumers of sugar and sweet-tasting foods and beverages. Total per capita use of caloric sweeteners (on a dry-weight basis)—comprised mainly of sucrose (table sugar made from cane or beets) and corn sweeteners (notably high-fructose corn syrup, called HFCS)—rose 16 percent by 1992 from 1980-83 (table 4). (Also see "Food Consumption Trends...At a Glance," following this article.) In 1992, Americans consumed, on average, a record 144 pounds of caloric sweeteners, compared with 124 pounds per person annually in 1980-83. That is more than one-third pound of added sugars a day for each American.

A striking change in the availability of specific sugars has occurred in the past decade. Sucrose's share in total caloric sweetener consumption dropped from 62 percent in 1980-83 to 45 percent in 1992. In contrast, corn sweetener's share increased from 37 percent in 1980-83 to 54 percent in 1992. All other caloric sweeteners

Table 4

Although Use of Sweeteners Rose 24 Percent, Sucrose Lost Share to High-Fructose Corn Syrup and Aspartame

Item	Annual average			Change, 1980-83 to 1991
	1980-83	1991	1992	
	Pounds per capita			*Percent* [1]
Total sweeteners	133.6	164.9	NA	23.4
Caloric sweeteners[2]	124.0	140.6	143.8	13.4
Sucrose[3]	76.8	63.8	64.5	-16.9
Corn sweeteners	46.0	75.4	77.9	64.1
High-fructose corn syrup	24.9	50.7	52.3	103.4
Glucose	17.1	20.2	21.1	18.1
Dextrose	3.9	4.5	4.5	15.5
Honey and edible syrup[4]	1.3	1.4	1.4	4.5
High-intensity sweeteners[5]	9.6	24.3	NA	153.4
Saccharin	8.4	7.3	NA	-13.2
Aspartame	1.2	17.0	NA	1,344.6
Candy[6]	16.7	20.8	21.4	24.1

Notes: Totals may not add due to rounding. NA = Not available. [1]Calculated from unrounded data. [2]Dry-weight basis. [3]Table sugar made from cane or beets. [4]Contains estimates of sorgo, maple, cane, molasses, and refiner's syrup. [5]Sugar-sweetness equivalent (SSE). Assumes saccharin is 300 times as sweet as sugar (sucrose) and aspartame is 200 times as sweet. [6]The sweeteners used in making candy are also included in the estimates above.

combined—including honey, maple syrup, and molasses—maintained a 1-percent share during the same period.

Per capita use of high-intensity, or low-calorie, sweeteners (mainly aspartame and saccharin) has more than tripled since 1980 to a level approaching 25 pounds (sugar-sweetness equivalent) per year. (For more details on this product and market, see "Have High-Intensity Sweeteners Reached Their Peak?" in the September-December 1993 *FoodReview*.) This share of the total sweetener market grew from less than 6 percent in 1980 to 15 percent.

Per capita use of sucrose dropped from 84 pounds per person in 1980 to a low of 60 pounds per person in 1986. Use of sucrose increased since 1986—reaching 64.5 pounds per person in 1992.

Much of the displacement of sucrose by HFCS and aspartame has been in soft drinks. Between 1980 and 1992, beverage manufacturers reduced their use of sucrose from 19 pounds to 1 pound per capita. Similarly, canned, bottled, and frozen food manufacturers together cut their use of sucrose from 4.5 pounds to 2.5 pounds per capita over the same period, as they substituted corn sweeteners for sucrose and as consumers substituted fresh fruit and fruit canned in juice or light syrup for fruit canned in heavy syrup.

The uptick in sucrose consumption since 1986 reflects increased use by industrial bakers, confectioners, and breakfast cereal manufacturers. The percentage of supermarkets with instore bakeries jumped from 39 percent in 1980 to 60 percent in 1988, according to *Progressive Grocer*. This percentage has been stable for the last 5 years, but bakery sales continue to far outpace the stores' total sales. Sweets—cakes, doughnuts, cookies, pies, and pastries—accounted for roughly two-thirds of service bakery sales in 1992. The fastest-growing bakery item is cakes.

Use of corn sweeteners (HFCS, glucose, and dextrose) rose from 39 pounds (dry basis) per capita in 1980 to a record 78 pounds in 1992, mainly because of HFCS. Use of HFCS, which is significantly less expensive than sucrose, rose from 18 pounds per person in 1980 to 52 pounds in 1992. In 1992, beverages accounted for 71 percent of total HFCS deliveries for domestic food and beverage use, compared with 36 percent in 1980. Use of HFCS in bakery products and processed foods has jumped even higher since 1990.

If the per capita food supply estimates—which show a 16-percent increase in total caloric sweeteners and a tripling in HFCS since 1980—accurately reflect trends in actual consumption, then each American, on average, now consumes signifi-

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cantly more added fructose than in 1980. (Sucrose is half fructose; HFCS-55 is 55 percent fructose and accounts for more than three-quarters of the increased use of total HFCS since 1980; HFCS-42 accounts for the remainder.)

This apparent increase gives rise to concern among nutritionists because evidence implicates diets high in fructose with increased blood lipid levels. (Lipids is the technical term for fats, waxes, and fatty compounds.) A task force of scientists convened by the Food and Drug Administration found in 1986 no conclusive evidence that a high sugar intake is a risk factor for heart disease, whether by raising blood cholesterol, triglycerides (a fat in the blood), or blood pressure, "in the general population." However, some researchers suggest that a small number of "carbohydrate-sensitive" individuals—such as those with insulin or triglyceride levels that are high to start with—may be particularly sensitive to sugar (especially fructose) and respond with raised cholesterol and triglyceride levels. USDA's Agricultural Research Service is expanding its research of this issue.

One quarter of the calories available from the 1990 per capita food supply (excluding alcoholic beverages) came from sugars. Lactose from milk and the sugars occurring naturally in fruit and vegetables accounted for roughly one-fourth of this amount. The remaining three-fourths—about 19 percent of total calories—was from sugars added to foods.

Sugar—including sucrose, corn sweeteners, honey, and molasses—is, in a sense, the number-one food additive. It turns up in some unlikely places, such as pizza, bread, hot dogs, boxed rice mix, soup, crackers, spaghetti sauce, lunch meat, canned vegetables, fruit drinks, flavored yogurt, ketchup, salad dressing, mayonnaise, and some peanut butter.

Nearly one-fifth (18 percent) of the added sugars in the U.S. food supply comes in carbonated soft drinks. A 12-ounce cola contains 9 teaspoons of sugar. Each American consumed, on average, roughly 30 gallons of sugared soft drinks in 1992—about 10.5 ounces a day, an amount that contains about 8 teaspoons of sugar.

The new food label, which lists the amount of sugars in grams (4 grams is equivalent to 1 teaspoon) in a serving of the food, can help people who are trying to moderate their sugar intake. This number includes both added sugars and those naturally present. Foods with natural sugars, such as milk and fruit, are also good sources of other nutrients, such as vitamins and minerals.

New products may also help. Food processors are introducing many "no added sugar" and "reduced sugar" foods. New sweeteners will likely enter the market in the next decade. With more alternative sweeteners, food processors can custom-blend caloric and high-intensity sweeteners to reduce calories and to achieve an optimum combination of taste, cost, and functional properties for specific applications.

Beverages

U.S. per capita soft drink consumption jumped 29 percent from 35 gallons per person in 1980 to 45 gallons in 1992 (table 5).

Supermarket customers spend more money on carbonated soft

Table 5
Soft Drinks Are By Far the Most Popular Beverage

Item	Annual average			Change, 1980-83 to 1992
	1980-83	1991	1992	
	Gallons per capita			*Percent* [1]
Soft drinks[2]	35.3	44.9	45.4	28.8
Coffee	26.3	27.1	26.9	2.5
Milk	26.8	25.7	25.3	-5.5
Juices[3]	7.3	7.3	6.8	-6.0
Citrus	5.9	5.2	4.9	-17.0
Apple	1.0	1.7	1.5	46.9
Grape	.3	.3	.4	52.4
Prune	.1	—	—	-66.7
Tea	7.1	6.9	7.1	-.2
Bottled water[4]	2.9	8.0	8.2	187.5
Club soda/seltzer	.5	.8	.8	53.2
Alcoholic beverages	28.5	26.4	26.1	-8.5
Beer	24.4	23.1	22.8	-6.3
Wine	2.2	1.9	1.9	-15.5
Distilled spirits	1.9	1.4	1.4	-28.1

Notes: Totals may not add due to rounding. — = Less than 0.05 gallon. [1]Calculated from unrounded data. [2]Revised in accord with the Census of Manufactures. [3]Single-strength equivalent. Data unavailable for pineapple, cranberry, and other juices. [4]Source: Beverage Marketing Corporation.

drinks than any other product scanned at the checkout counter (excludes fresh meat and poultry, whose prices are usually keyed-in and not scanned), according to a study by Information Resources, Inc. In 1992, soda-fountain sales of soft drinks increased by more than 4 percent, while the industry's bottle and can sales grew at 1.5 percent or less, according to *Beverage Digest*, a trade publication. The growth reflects a huge marketing and promotional push by soft-drink makers, who face shelf-space limitations, discounting, and growing competition from private labels and alternative drinks in grocery stores.

Fountain drinks, which now account for a quarter of soft-drink industry sales, are getting a big push from so-called "combo meal" deals at fast-food places. (These fixed-price discount meals of, for example, burgers, fries, and soft drinks generally promote the beverage being free.) And, the drinks are getting bigger. When Wendy's increased the medium drink in its combo meals to 20 ounces from 16 ounces, its soft-drink sales increased at least 10 percent. Now, Wendy's offers a 32-ounce "Biggie" drink for 8 to 10 cents more. In 1992, Subway came out with a 44-ounce drink.

For the U.S. population age 21 years and older, per capita consumption of alcoholic beverages reached a record high 43.1 gallons in 1981, but it declined steadily to 37.4 gallons by 1992. Between 1981 and 1992, annual average beer consumption declined 11 percent to 32.7 gallons per adult, and average wine use declined 18 percent to 2.7 gallons per adult. Average consumption of distilled spirits declined by half between 1981 and 1992 to 2 gallons per adult (the same as 1991's 21-year low).

"Despite considerable progress toward a lower fat, higher carbohydrate diet in the past decade, per capita use of caloric sweeteners has reached an all-time high and average fiber intake remains very low."

As measured in the Consumer Expenditures Surveys conducted by the Bureau of Labor Statistics, mean annual household expenditures for alcoholic beverages (in constant 1992 dollars) decreased by 36 percent between 1980 and 1992 (from $470 to $301). Spending for alcoholic beverages is expected to continue to decline, and the number of households purchasing alcoholic beverages is also likely to continue shrinking.

Indications of a trend toward less widespread alcohol consumption may reflect changing demographics—a smaller percentage of the population is in peak drinking years. The proportion of the population over age 60 is increasing—this segment is less likely to indulge. Age groups with higher incomes and more leisure time are becoming less likely to spend money on alcoholic beverages and are the most receptive to moderation-based appeals centered on safety, health, and fitness.

Sharply higher Federal excise taxes added to all alcoholic beverages beginning January 1, 1991, also may have curtailed alcoholic beverage consumption since then. In addition to the tax increases, some manufacturers raised prices. Between 1990 and 1992, retail prices, as measured in the Consumer Price Index (CPI), for packaged alcoholic beverages (excludes alcoholic drinks served in bars and foodservice establishments) increased by 15.6 percent versus 3.4 percent for the CPI for food at home. ▨

Food Consumption Trends . . . At a Glance

There has been a striking change in the proportion of carbohydrates from starches and from simple carbohydrates (sugars).

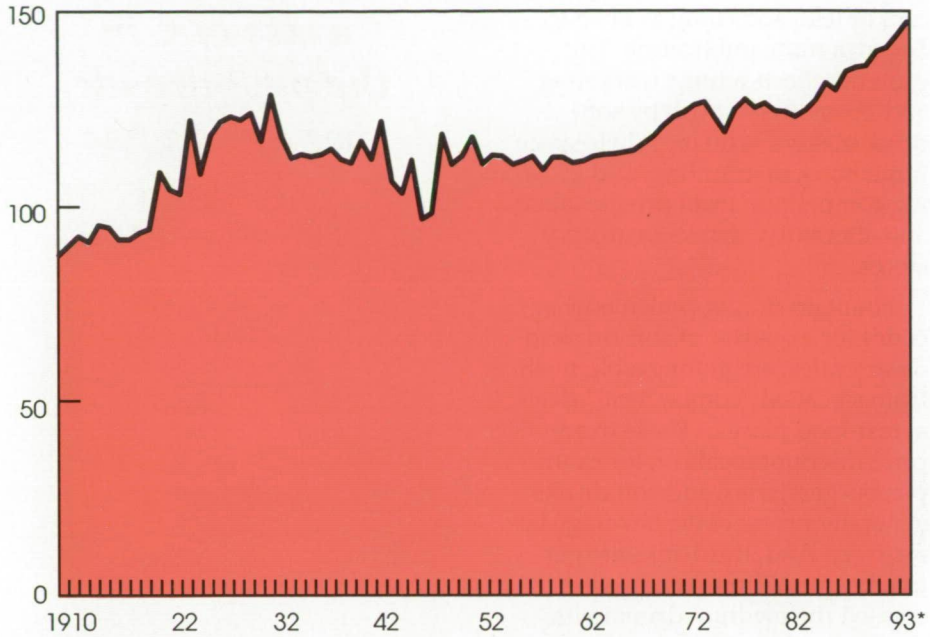
The use of grain products and potatoes has decreased, while the use of refined and processed sugars has increased.

From 1910 to 1913, only one-third of the carbohydrates came from sugars. But by 1990, this had increased to one half.

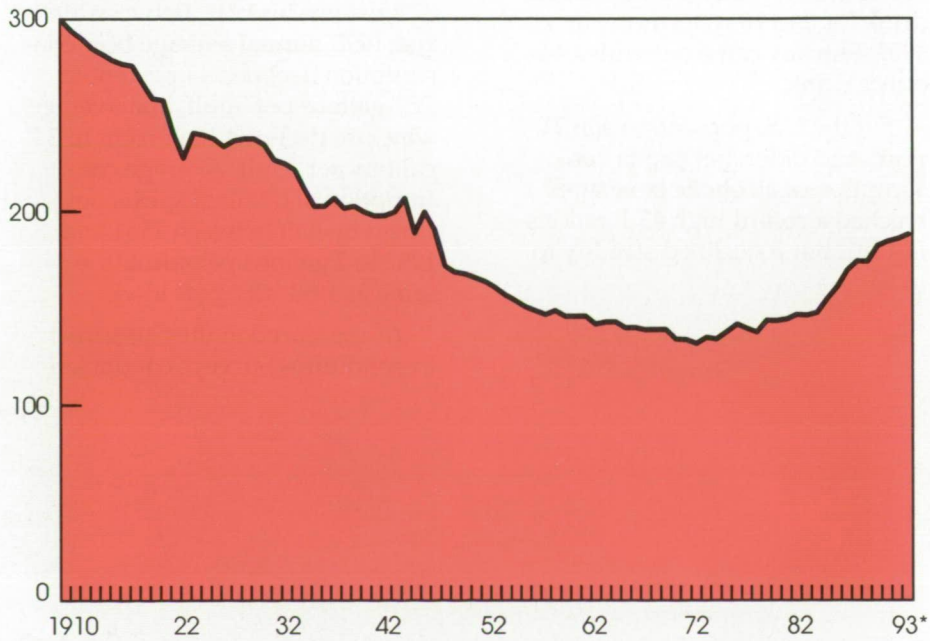
Today, much of the carbohydrates in the U.S. food supply comes from foods like candy, sweet baked goods, sugared soft drinks, and table sugar.

...For more details, contact Judith Jones Putnam at (202) 501-7413.

Caloric Sweeteners, U.S. Consumption
Pounds per capita



Flour and Cereals, U.S. Consumption
Pounds per capita



*1993 preliminary data.

Domestic Food Assistance Programs Grew Significantly in 1993

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Approximately 40 million Americans received food assistance from the Federal Government in fiscal 1993, including food stamps, vouchers, food packages, or cash.

To provide this assistance, the U.S. Government spent $35.2 billion in fiscal 1993 (table 1), 5.4 percent above fiscal 1992, and 80 percent over the $19.9 billion spent in 1984. In fiscal 1993, all programs expanded—especially the Food Stamp Program—despite a drop in the unemployment rate from 7.4 to 6.8 percent.

The Food Stamp Program is the largest of the Federal food assistance programs in terms of both the number of people served and the amount of money spent. Nearly 27 million participated each month in this program, a 1.6-million increase from fiscal 1992.

Although all programs have grown continually over the decade, the growth has been uneven, with the greatest proportion of the increase observed since 1990. Three factors help explain this growth. First, inflation causes program costs to rise each year. Second, rising unemployment and increased economic need associated with the recession of 1990-91 and the weak economic recovery that followed created additional demand for food assistance—particularly food stamps. Third, the large accumulation of surplus Government commodities—particularly dairy products—which fostered major increases in food donations during the mid-1980's was substantially depleted by 1990.

USDA's food assistance programs are designed to improve the nutritional well-being of low-income people and other target groups, such as children and the elderly. These programs, administered by USDA's Food and Nutrition Service, were initiated during the Great Depression in the 1930's. Developed to help feed the poor

The Food Stamp Program dominates domestic food assistance efforts, accounting for over two-thirds of the dollars spent in 1993. The program served an average of 27 million people each month in fiscal 1993.

The author is an agricultural economist with the Commodity Economics Division, Economic Research Service, USDA.

Table 1
USDA's Food Assistance Costs Rose 5.4 Percent in Fiscal 1993

Fiscal year	Food stamps[1]	Food donation[2]	WIC[3]	Child nutrition[4]	Total[5]
			Million dollars		
1984	12,407.5	1,489.8	1,388.1	4,265.9	19,634.2
1985	12,531.9	1,439.2	1,489.3	4,391.0	19,935.9
1986	12,462.1	1,380.9	1,582.9	4,625.5	20,129.9
1987	12,461.4	1,313.1	1,679.6	4,883.3	20,421.6
1988	13,199.7	1,074.3	1,797.5	5,047.0	21,204.4
1989	13,844.3	723.5	1,910.7	5,060.5	21,787.4
1990	16,431.5	720.8	2,122.5	5,475.8	24,875.8
1991	19,736.8	691.3	2,301.1	6,098.1	28,696.4
1992	23,468.2	702.9	2,596.8	6,712.1	33,355.8
1993	24,694.2	686.6	2,818.5	7,143.4	35,258.5

Notes: [1]Includes benefits, State administrative expenses, other program costs, and Nutrition Assistance to Puerto Rico and the Northern Marianas (FY 1982 through FY 1990). Excludes transfers. [2]Includes all costs of the following programs: Needy family (Food Distribution to Indian Reservations), Nutrition Program for the Elderly, Commodity Supplemental Food, Charitable Institutions, Temporary Emergency Food Assistance, and Commodities for Soup Kitchens. Excludes commodities for Child Nutrition programs. [3]Includes program evaluation funds (for FY 1980 onward), bonus commodities for FY 1982–85, and Farmers Market Demonstration Projects in FY 1989 and FY 1990. [4]Includes School Programs, Child Care Food Program, Summer Food Service Program, Child Nutrition State administrative expenses, Nutrition Education and Training Program, Nutrition Studies, and Food Service Equipment Assistance Program (through FY 1981). [5]Includes Food Program Administration funds.

and unemployed and to stabilize farm prices, the programs initially distributed growing Government stocks of surplus agricultural commodities. Since then, some assistance programs have been expanded and new programs have been implemented to provide assistance to a growing number of Americans.

Food Stamps

Dominating domestic food assistance efforts, the Food Stamp Program accounted for more than two-thirds of the dollars spent in 1993. An average of 27 million people participated each month in fiscal 1993 (table 2), up from 25.4 million in 1992.

Because this program is so responsive to the health of the economy, it grew substantially as a result of the recession of 1990-91 and the weak economic recovery that followed contributing to the growth in the number of unemployed and poor. The rise in program costs accounts for three-fourths of the total increase in all food program costs since 1984.

The Food Stamp Program helps low-income households purchase the foods they need for better nutrition. Participants are able to use coupons to purchase certain foods. The program operates in all 50 States, the District of Columbia, Guam, and the U.S. Virgin Islands. Puerto Rico participated until 1982, when it established a separate Nutrition Assistance Program.

In order to be eligible for food stamps, people must meet income guidelines, asset limitations, and certain work requirements. Monthly benefits are based on income and household size. The dollar amounts are adjusted annually to reflect changes in the cost of the Thrifty Food Plan, the most economical of four food plans published by USDA.

Table 2
Growth in Food Stamp Participation and Costs in Fiscal 1993 Occurred During a Period of Economic Expansion

Fiscal year	Average monthly participation	Average monthly benefit	Total cost
	Millions	*Dollars*	*Million dollars*
1984	20.9	42.7	11,497
1985	19.9	45.0	11,621
1986	19.4	45.5	11,558
1987	19.1	45.8	11,535
1988	18.6	49.8	12,269
1989	18.8	51.9	12,893
1990	20.1	58.9	15,436
1991	22.6	63.8	18,690
1992	25.4	68.6	22,460
1993	27.0	68.0	23,650

The Food Stamp Program increases the food buying power of participating households and indirectly supplements their incomes. Recipients use the value of their food stamps to purchase food. In some cases, food stamps replace income previously allocated for food. This substitution frees up income for the purchase of nonfood items.

Child Nutrition Programs

USDA operates five assistance programs in cooperation with State and local governments to provide meals and snacks to preschool and school-age children: National School Lunch, School Breakfast, Special Milk, Child and Adult Care, and Summer Food Service Programs. In fiscal 1993, Federal expenditures for these programs totaled $7.1 billion, a 6.6-percent increase over fiscal 1992.

Through USDA's food programs, over 30 million meals are served each school day to children enrolled in public and private schools, and another 2 million children are served in the Child and Adult Care Food Program.

The National School Lunch Program is the largest of these, having served 24.9 million children on a typical school day in fiscal 1993. That participation is an 0.8-percent gain over fiscal 1992, with the number of free and reduced-price meals up 4.6 percent and 1.0 percent, respectively. The rate of participation in the free and reduced-price lunches, which are subsidized at higher levels and available only to economically eligible students, is closely related to the well-being of the general economy.

Participation in the School Breakfast Program rose over 8 percent to 5.3 million students per school day in fiscal 1993. Outlays increased 10 percent from $786.6 million to $866.0 million (table 3).

The Child and Adult Care Food Program provides cash and commodities for food service for children in nonresidential child care centers and family daycare homes and for chronically impaired adults and persons over age 60 who are enrolled in adult daycare centers.

This program served 1.3 billion meals during fiscal 1993, a 9.1-percent increase over the 1.2 billion served in 1992. Average daily participation rose from 1.93 million people in 1992 to 2.06 million in 1993.

In the past decade, this was the fastest growing food-assistance program due to the increased numbers of children who required child care services and growing public and Government concern about low-income working mothers and their children.

Supplemental Food Programs

The Special Supplemental Food Program for Women, Infants, and Children (WIC) was established in 1972 to improve the nutrition and health of pregnant, breast-feeding, and postpartum women, as well as infants under 1 year of age and children up to age 5, who are determined by health or medical professionals to be at nutritional risk.

An average of 5.9 million people participated each month in fiscal 1993, a 9.6-percent increase over the previous year. Average monthly food benefits in 1993 were $29.82, compared with $30.20 in 1992.

The WIC program provides vouchers that can be exchanged for monthly allotments of foods which are designed to supplement each participant's diet with items that are typically lacking in the target population, such as infant formula, eggs, fruit, juice, milk, cheese, and cereal. The program also provides eligible recipients with nutrition and health education and information concerning access to available

Table 3
Assistance for School Food Programs Reached $5.6 Billion in Fiscal 1993

Fiscal year	School lunch	School breakfast	Special milk	Commodities	Total
			Million dollars		
1984	2,507.7	364.0	16.0	827.4	3,715.1
1985	2,578.4	379.3	15.8	801.3	3,774.8
1986	2,714.5	406.3	15.5	821.9	3,958.2
1987	2,797.1	446.8	15.5	888.2	4,147.6
1988	2,916.4	482.1	18.7	813.7	4,230.9
1989	3,005.7	513.2	18.5	764.2	4,301.6
1990	3,213.9	596.2	19.2	619.7	4,449.0
1991	3,524.7	685.0	19.8	699.2	4,928.7
1992	3,856.4	786.7	19.5	707.3	5,369.9
1993	4,080.0	868.3	18.7	680.0	5,647.0

community health and medical services. Total costs for this program rose 8.5 percent in 1993 from $2.6 billion to $2.8 billion.

Begun in 1969, the Commodity Supplemental Food Program serves a target population similar to WIC's as well as low-income elderly people. The program provides monthly food parcels to about 370,800 people, nearly 40 percent of whom are elderly. Like WIC, this program has expanded in the past decade, although it is much smaller.

Participation grew substantially after 1982, when the elderly became eligible for such benefits. Growth has declined somewhat since 1991, as fewer commodities have become available for distribution and as participants have joined the WIC program.

Food Donation Programs

Due to the reduction of Government stocks of surplus commodities, expenditures for food donations have fallen off since the mid-1980's. Total costs of distributions in 1993 amounted to $652.7 million, approximately the same level as the past 4 years.

These programs provide outlets for surplus stocks acquired through price-support programs. For the last several years, Government inventories have been too low to maintain the volume of shipments that were available to these programs in the 1980's. As a result, USDA has been required to purchase foods to supplement the donated commodities.

The donations go through a number of programs to many recipients, including American Indians on reservations, people living in the Trust Territories of the Pacific Islands, the elderly, and needy families. In addition, USDA donates foodstuffs to charitable institutions, summer camps, soup kitchens, and food banks.

Improvements—and Continued Growth—Expected

In school year 1993-94, USDA initiated an effort to improve the nutritional balance of meals served in schools, with emphasis on more fruit and vegetable servings and on less sweets, fats, cholesterol, and sodium in the menus. This initiative will help schools design meals which conform to the *Dietary Guidelines for Americans*.

The impact of this initiative on program costs, participation, and the nutritional intake of students will be analyzed by USDA's Food and Nutrition Service in the coming months.

Funding for programs which are directed to provide aid to infants and children, such as WIC and the Child Care Program, is expected to continue growing through the decade.

Preliminary figures for the Food Stamp Program in fiscal 1994 indicate that participation continues to increase, although the rate of increase has slowed from the levels of the last few years. During periods of economic recovery and growth in the past, the program's participation had leveled off and declined. The Food and Nutrition Service is currently embarked on an effort to identify structural changes that would explain this departure from historical patterns. ▩

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